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Contents.

	PAGE
British Metallurgical Progress in Cast Iron	99
Steel Castings	99
Educating the Apprentice	100
Correspondence	100
I.B.F. Branch Presidents—No. 3	100
Calendars, etc., Received	100
Random Shots	100
The Use of Aluminium as a Decorating Medium	101
Press Service Department at the B.I.F.	101
Moulders Dispute Settled	101
The British Cast-Iron Research Association	101
Steel Foundry to be Dismantled	101
Indian Locomotives for England	101
International Foundry Trades' Exhibition	101
Foundry Purchasing—XXXII	102
Scots Iron Workers' Dispute	102
Refractory Materials	103
Patent Specifications Accepted	104
The Continental Steel Trust	104
Symposium on Steel Castings	105
British Columbia Iron and Steel Bounties	106
Thomas Turner Medals	106
Potentialities of Alloy Cast Irons	107
New Companies	108
Institute of British Foundrymen	109
Blast-Furnace Practice in Germany	112
Trade Talk	114
Company Meetings	114
Contracts Open	114
Obituary	114
Personal	114
Iron and Steel Markets	116

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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The Registered Office and Laboratories of the B.C.I.R.A. are at:
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Telephone: Central 1885. Telegrams: CIRA.
The B.C.I.R.A. Scottish Laboratories are:—
Foundry Technical Institute, Meek's Road, Falkirk (*Telephone 332*)

Forthcoming Events.

FEBRUARY 12.

Sheffield Metallurgical Association:—Ordinary meeting at Sheffield. "Metallurgical Post-mortem Examinations," Paper by A. Parker Hague.

Institute of Metals (North-East Coast Local Section):—Ordinary meeting at Newcastle-on-Tyne. "Metallurgy of Engineering," Paper by J. E. Newson, M.Met.

FEBRUARY 13.

Institute of Metals (Swansea Local Section):—Ordinary meeting at Swansea. "Recent Developments in Rolling Metal Strip and Sheet," Paper by J. E. Malam.

FEBRUARY 14.

Institute of Metals (Scottish Local Section):—Joint meeting with the Institution of Engineers and Shipbuilders and Institute of British Foundrymen at Glasgow. "Alloys: Past, Present and Future," Paper by W. Rosenhain, D.Sc., F.R.S.

Society of Chemical Industry (Birmingham and Midland Section):—Ordinary meeting. "Disposal of Ammonia Liquors," Paper by D. W. Parkes, F.I.C.

Institute of British Foundrymen.

FEBRUARY 12.

Lancashire Branch (Burnley Section):—Ordinary meeting. "Some Aspects of Modern Foundry Practice," Paper by Mr. Griffiths.

FEBRUARY 14.

London Branch:—Ordinary meeting. "Theory and Practice of Gun Metal Casting," Paper by H. C. Dews and G. C. Pierce.

Scottish Branch (Junior Section):—Ordinary meeting at Glasgow. "Alloys," Paper by H. Hyman, B.Sc., Ph.D.

FEBRUARY 16.

Birmingham Branch:—Joint meeting at Derby. Visit to Messrs. Combustion Engineering Company, Limited, and Lecture by R. Greenwood.

British Metallurgical Progress in Cast Iron.

Yesterday we were present by invitation at a meeting of the Research Committee of the British Cast Iron Research Association, at which three new research reports were considered. We do not propose to comment on the subject matter of the reports, for they are still confidential, but we were greatly impressed with the progress recorded.

Perhaps the outstanding feature conveyed in them was the evidence of what can only be described as team work. The material prepared would have taken an ordinary investigator working alone many years to complete. But in the C.I.R.A. the industry evidently has an organisation which functions as a whole—in which there is evidence not only of skill and energy in control, but also detailed support in the multitude of melts, chemical analyses, mechanical tests and microscopical examinations essential in work of this kind. The wealth of foreign material reviewed and considered shows the work of an effective library and translation service.

Altogether it seems to us that only by an organisation like the C.I.R.A. can the work of investigators such as Professor Turner and the school which he began forty years ago be carried to completion on a practical scale and applied in the industry, and that the C.I.R.A. in this respect is about a quarter of a century overdue, for much of this work is only just beginning to be understood on a practical scale.

The industry needs the help of all the work the Universities can do, and the active encouragement and sympathy of the C.I.R.A. should stimulate them to consider the problems of the industry—whether they be refractories, combustion, metallurgy or moulding.

As for the subject matter dealt with at the meeting, it marks a new chapter in the history of cast iron, as some of the metallurgical experts present were not slow to suggest. For the first time we felt that Great Britain might soon equal the achievements of Germany, whose lead not long ago it seemed hopeless to try and recover, and even put herself in a special place by virtue of the close association between theory and practice which the constitution of the C.I.R.A. permits. Wherever new facts were brought to light a rational explanation of them was forthcoming.

We say *might equal* advisedly, because so much depends on getting the support of those in the industry who do not yet subscribe, but who cannot help but share the benefits of published results. But the officers of the Association are fully alive to commercial applications, and naturally members get first chance. Indeed, while it is advisable on many grounds to publish scientific papers (and at least one is to be given to the June Convention) there are many founders who would not see in a purely scientific and technical study the practical application any more than they have done in the older papers referred to above. Those who hope to share the benefits through participating in published results are likely to find that they suffer the same delay as the whole industry has hitherto experienced.

Steel Castings.

We are not altogether too satisfied with the deliberations of the joint conference on Steel Castings recently held in Glasgow between the local sections of the Institute of Mechanical Engineers and the Institute of British Foundrymen. We detected here and there a tendency to score a point off the other side. Beyond a pious hope, expressed by all parties, for a more complete co-operation, nothing has been done to ameliorate what is stated to be a parlous condition in the industry. What the conference has done, however, is to awaken intense interest which must not be allowed to die down. Thus we consider it essential that a further conference should be held next autumn with Sheffield as the venue. Moreover, efforts should be made to ensure the active co-operation of the steel founders of the North-East Coast, the Midlands, and the two in the South of England. We have considered fairly intensely the problems introduced by X-ray inspection, and we suggest that its application to the steel castings industry should function on the following lines:—

Facilities for X-ray examination should be placed at the disposal of the individual foundry by (*a*) either the Government Departments interested in the use of steel castings, or (*b*) a co-operative organisation supported by the foundry, and for this service a fee would be charged. This arrangement would be necessary, as its object would be to control moulding operations and to aid research.

As a countervailing entity, we insist that all castings subject to X-ray examination should carry a bonus for the manufacturer. Moreover, it should be agreed that no casting, unless specifically marked on the order or contract as being subject to X-ray test, should be rejected on failure to pass inspection. We ask the Admiralty, when considering the reception of steel castings, to bear in mind armour-plate practice, wherein a third is cut from the top of the ingot; a third from the bottom, and then often the centre of the ingot is trepanned out. There never was or will be a perfect sand-cast steel casting of a complicated character if judged by the standard of breaking up cast-iron castings (an easier metal to cast) to small fragments.

XUM

Educating the Apprentice.

Mr. A. T. Gibbs gave an interesting talk to the members of the London Junior Section of the Institute of British Foundrymen at a meeting held at the offices of the Industrial Newspapers, Limited, on Friday, January 25.

The lecturer said that he wished his address to be regarded as purely a friendly talk by one who had been through the mill himself and knew that it was only hard work and perseverance which enabled a man to reach the top of the ladder in his trade.

He fully realised that a moulder could be a good moulder without having technical knowledge, or, indeed, much education at all, but these things were essential if he wished to rise to a higher position.

As a course of evening classes for the apprentice the lecturer suggested the following. If the lad started in his trade at about 14 years of age he (Mr. Gibbs) did not think that evening classes should be taken during the first year or two of his apprenticeship, because a complete change from school life often did the lad good and made him all the keener on his evening classes later.

As an essential part of the ambitious apprentice's education, Mr. Gibbs suggested the following syllabus:—(1) The first year at classes should be devoted to a course of elementary arithmetic and writing; (2) the next year to a study of elementary machine construction and drawing, with elementary practical mathematics; (3) one year to advanced machine construction and drawing, and advanced practical mathematics, with elementary inorganic chemistry; (4) a second year of inorganic chemistry with physics and magnetism electricity; (5) a third year could, with advantage, be devoted to inorganic chemistry, together with a course of elementary metallurgy, including the manufacture of iron and steel and the testing of materials; (6) the next year could be devoted to advanced metallurgy, second-grade pyrometry and metallography, and analytical metallurgy, and (7) during the next year he should be ready to take his final examination in iron and steel and in the non-ferrous section, and a second year at metallography and pyrometry.

The author was of the opinion that when a boy had reached 21 years of age he should begin to try to get as much experience in other branches of his trade as possible, and he thought that opportunity ought to be given to him to acquire that experience. In conclusion, he pointed out that it was most important for a lad to watch his personal appearance, and also to try to improve his mode of speech if he wished to be successful in the world.

An interesting discussion followed Mr. Gibbs' address, after which a hearty vote of thanks was accorded.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

The Silacene Competition.

To the Editor of The Foundry Trade Journal.

Sir,—It has come to our notice insinuations are being made by certain persons that the list of prize winners in connection with our Christmas competition was not genuine.

In our advertisement this week we publicly invite these persons to inspect the correspondence in connection with that competition. At the same time, as the competition and result were published solely in your Journal, we should be greatly obliged if you would send a representative to also inspect all the correspondence at these offices. We should appreciate this opportunity of replying to any questions he may care to raise and to prove to his satisfaction that the published list of prize winners was perfectly genuine.—Yours, etc.,

Per. Pro.
Thomas E. Gray & Company, Limited.
Thos. H. Gray,
Managing Director.

119, High Holborn, London, W.C.1.

I.B.F. Branch Presidents—No. 3.

West Riding of Yorkshire Section.

Mr. W. G. Thornton, the president of the West Riding of Yorkshire Branch of the Institute of British Foundrymen, gained his first experience in the engineering and foundry world when he entered the works of Messrs. Thornton & Crebbin, Ironfounders and Engineers, of Bradford, as an apprentice. Being the son of one of the proprietors of the firm he was privileged by being allowed to spend a certain time in each of the departments, including the drawing office, pattern shop, foundry, machine shops, fitting and erecting shops, and finally the office. The technical

Mr. W. G. Thornton.

side of his experience was acquired at the Bradford Technical College.

After his apprenticeship had been completed he received a position with the firm of Messrs. Cole Marchent & Morley, Limited, Bradford (engine builders), as assistant works manager, later (during the war) being appointed foundry manager, this position being held until 1926, when he formed the Yorkshire Repetition Casting Company, Limited, Eastbrook Foundry, Dick Lane, Bradford, of which he is the managing director.

He commenced attending lectures of the Yorkshire Branch, which were then held in Halifax, when a youth of 18, and has continued to associate himself with the Institute ever since.

Calendars, Etc., Received.

Since the publication of our last list we have received from August's Muffle Furnaces, Limited, a large wall calendar of a rather unusual type, in that it commences from February, and includes January, 1930, to complete the year: from The British Chilled Roll & Engineering Company, Limited, Haverton Hill, Middlesbrough, a desk blotter, to which is attached an engagement calendar: from Mr. B. T. King, 145a, Queen Victoria Street, E.C.4, a neat pocket diary: from H. C. Blackwell, Sons & Company, Limited, Blackwells Metallurgical Works, Liverpool, a tear-off wall calendar, illustrating their works: from W. E. Horsman, Son & Company, Eveline Road, Mitcham, a calendar of bold design: from The Société Anonyme Silica, Nimy-lez-Mons, Belgium, through their agent, Sydney Evans, 22-23, Laurence Pountney Lane, E.C.4, a leather-bound diary of exceedingly handsome finish, containing a description of their foundry sands and numerous mathematical and technical tables, and from Spencer and Halstead, Limited, Osset, near Leeds, a wall calendar shaped in the form of a cowl.

Random Shots.

It is very curious, following my recent remarks on detective stories, that I should have this week struck a detective story that deals with ironfounding. I do not think that ironfounding has ever been made the theme of a novel, but this is a very close approach to it. The author is Francis Everton, and the book is the "Hammer of Doom." The foundry details are quite convincing (contrary to most industrial local colour), but the author certainly assumes novelists' license in dealing with an invention for improving castings.

* * *

The scene is laid in Derbyshire, and the works concerned can be readily perceived behind their thin disguise, for the town is "Castlefield," with a "twisting, sloping steeple of the church," its "Station Hotel," and the foundry, "surprisingly adjacent to the market place of the busy little mining town."

* * *

The plot concerns the discovery of an improved way of making castings by the foundry manager, Shardlow, an unpopular and hard man of the old school, whose cynical pessimism causes him to address his managing director thus: "You can build a laboratory and fill it full of bottles. You can pay young Greenlow an extra couple of hundred pounds a year for sticking some letters after his name. You can join the Cast Iron Research Society or any other damned society you damned well choose. . . . In my opinion you might just as well stick the money in the cupola at once. Why you should think a row of little bottles, a couple of Bunsen burners, and a lot of gibberish about silicon contents and cementite are going to help us to work at a profit is beyond my understanding."

* * *

Surely the C.I.R.A. is the first Research Association to have achieved immortality in a novel? And surely the C.I.R.A. could have told this expert a few simple facts about electrical currents that would have saved him a lot of time and money? * * *

But listen to an explanation of the metallurgy of cast iron before coming to Shardlow's patent idea, as expounded by the hero to the heroine. "Why, he's got some secret method of making castings . . . really all a matter of crystallisation. Strong, dense castings have tiny crystals, weak castings have larger ones. Then again there's the carbon mystery. When iron is molten, all the carbon in it is in chemical combination with the iron, but when it cools and sets into a casting the iron can't combine with so much, and some of it falls out as graphite crystals. And the amount that falls out depends on the rate at which you cool it. If you cool it quickly then the iron crystals are small, and there's very little graphite. If you cool it slowly the iron crystals are bigger, and a lot of carbon crystallises out into flat plates of graphite that lie between the iron crystals and make the casting weak. . . . You can see that to make a large casting with thin bits and thick bits in it is a difficult matter. The iron and cooling speeds that are right for one part aren't right for the other." So far, so good. "Cast iron, why it's more tricky than human nature, and there are a thousand and one considerations that I haven't told you of. But to get on with it, what you have to do is to try to cool the thick parts more quickly than the thin, and to compromise in the mixture you melt for the casting. The Mooreton Company, over at Millingham, make pipes by spinning them—they spin the mould very quickly and the metal flies to the outside and makes a pipe; it sets as it spins, and that gives them small crystals; the fact that the metal's in motion prevents large crystals from forming—and there are other advantages, too. But it is only good for pipes and things like that. The moulds—they're made of metal—are too expensive, and it's too complicated to make it any real good for engine cylinders, for instance. And that's where old Shardlow thinks he's got them beat."

* * *

Shardlow's idea will have to wait until next week.

Marksman.

The Use of Aluminium as a Decorating Medium.

The use of aluminium paint is now so well known that it needs no introduction here. It is not proposed to intrude it into this article further than to give a few hints on its use that may be new and to correct one or two errors in regard to it. The present purpose is rather to refer to other uses of aluminium not so well known to the general reader, but of considerable interest to all concerned in any way with decoration of goods or buildings.

Practically, the uses of aluminium as a method of decoration resolve themselves into a form of painting, but the modes of compounding the paint vary according to the previous preparation of the metal. This depends on the means of its future employment. For the ordinary aluminium paint now familiar to everyone, the metal is brought to a granular form, while in the preparation for the less known bronzing, it is flaked by special processes and polished. In the latter case the metal is reduced to a fineness that may be compared to gold leaf, and this in turn is broken up into minute particles of a flaky nature. The polishing is effected by means of revolving brushes in corrugated cylinders into which the fine flakes are poured with the addition of a suitable grease.

In whatever way aluminium is used for decorating iron or steel, the electro-positive nature of the covering is a valuable asset as a protector of the under metal. It is not generally known what an affinity minute particles of aluminium, to the extent of 1 or 2 per cent., have, providing contact is maintained long enough. This is knowledge worth assimilating by those who are responsible for the protection of iron and steel goods and structures. Again, the immunity of aluminium from attack by sulphur or chlorine in the air means a longer life for the coating in seaside towns, or industrial centres like Manchester or Birmingham.

On wooden objects or structures the value of aluminium lies in a preliminary coating of all timber exposed to the atmosphere. The priming usually given to wood consists of lead paint, generally red lead mixed with turpentine. This fails in one respect completely, and in others partially. The former is in the case of knots which have first to be "stopped off" by special preparations, or they show through succeeding coats of paint. When an aluminium-coating is given, it answers both purposes satisfactorily. This "stopping off" quality of aluminium coatings is most practically useful in the case of timber structures that have been previously creosoted or tarred. No ordinary paint will dry on these, but aluminium can be used quite successfully, and it is as waterproofing as the materials it covers if at their best—in fact, more so in the majority of cases.

Aluminium-Bronze Powder.

It is perhaps when aluminium-bronze powder comes into play by various adaptable means that this metal becomes of most use decoratively. This powder is obtainable in its natural colour—a silvery whiteness or tinted in various colours, mostly reds, greens and blues. One advantage it possesses over many paint bases is the one of improving in colour with age, providing it is stored in a dry place. As this does not follow if kept in the usual medium for more than a brief span, it is best to mix only as much as can be used at once. The best medium for the purpose is one composed of varnish and linseed oil. The latter with sufficient turpentine is very frequently the only ingredient necessary to invest the ordinary aluminium powder, but for bronzing a varnish of good quality answers better. The lustre of the bronze powder assists in producing novel and striking effects in decoration where it is utilised. A beautiful shot-silk effect can be produced by using the white ordinary aluminium powder with various pigment-mixed paints. For instance, in one of red-oxide a lustrous effect is produced by the aluminium similar to a pink shot-silk fabric. A golden yellow bronze powder if mixed with a middle-green varnish paint gives a rich mixture difficult to describe, but very attractive. These, and similar effects, are produced on either wood or metal and are becoming popular in interior decoration. Of course, they should be employed with restraint, as in the case of all striking and bold effects.

Possible Effects.

There is a wide range of effects obtainable by varying the amount of the bronze powder in the same coloured paint. For example, a heavy proportion of red bronze with a medium to pale green paint will give a different appearance from one where the powder is half or a third the quantity. In the former case the green would be the subsidiary tone in the shot-silk effect, and in the latter the red would take that place. Where the powders alone were utilised to form the entire paint the effect would be more sparkling generally, and perhaps not so readily acceptable to some tastes as the more subdued tone of those combinations previously described.

The use of aluminium-bronze powders has enabled wallpaper manufacturers to obtain some new and pleasing effects at a cost which allows quite good paper to be placed on the market at a figure decidedly reasonable. For this purpose a rather coarser powder is used and is applied by spraying or dusting over. In the decoration of living rooms the ordinary white aluminium powder or paint can be utilised to assist in reflecting light to a considerable extent. Common aluminium paint will reflect 70 per cent. of light, which is about the same as ordinary white lead paint. The advantage it shows over the latter is in the retention of this power. As is well known, white lead paint is apt to turn yellow if subjected to an atmosphere impregnated by smoke and then it loses the power of reflection rather rapidly. In the course of three months this loss may amount to 15 or 20 per cent. On account of its superiority in this way aluminium paint is excellent for painting outside gates and railings in places unillumined by artificial light.

Press Service Department at the B.I.F.

Visitors to the British Industries Fair will find their trade and technical papers displayed at the joint exhibit of the Periodical, Trade Press, and Weekly Newspaper Proprietors' Association. At Birmingham the Stand No. is 10D/6, whilst at the White City it adjoins the Overseas Buyers' Club.

Every publication offers its services to British Industries Fair visitors, and all are cordially invited to make the fullest use of the service departments of the trade and technical press. A special Information Bureau will be available at the White City Stand, where subscribers', advertisers', and overseas buyers' inquiries will be expeditiously dealt with.

For those desirous of taking advantage of the opportunity representatives of the publications exhibited will be pleased to make appointments for interviews at the Bureau, and generally to assist in every way possible to meet the requirements of clients. Specimen copies may be obtained from the stand.

A joint exhibit will also be arranged under the auspices of the Association at the Ring Messhaus, Leipzig International Spring Fair, when similar facilities will be placed at the disposal of visitors.

Moulders Dispute Settled.

The moulders' wage dispute in the light-casting industry in Scotland has been settled. The ballot for and against the terms offered by employers has resulted as follows:—For acceptance, 989; against, 451. The result of the ballot means that the majority of the men in the principal district, Stirlingshire, have agreed to accept a 2½ per cent. reduction of wages immediately and 2½ per cent. reduction on April 1.

Fifteen hundred men engaged in the wrought-iron industry in Lanarkshire, who were rendered idle over a week ago as a result of a dispute, are still out.

MISS E. N. REYNOLDS has been appointed assistant librarian of the library of the British Cast Iron Research Association.

The British Cast-Iron Research Association.

The following were recently elected members of the Association:—Bailey Pegg & Company, Limited, Brierly Hill (J. H. Mees); Cammel Laird & Company, Limited, Sheffield (A. P. Hague); Kaye & Company (Huddersfield), Limited, Huddersfield (A. S. Worcester); The Parkinson Stove Company, Limited, Stechford (D. M. Gibb); Petters, Limited, Yeovil (L. B. Derry); and The Stafford Coal & Iron Company, Limited, Stoke-on-Trent (R. G. Stone).

As Asgsociate Members: C. E. Hodgkin, Reading, and C. L. Mason, Sheffield.

Steel Foundry to be Dismantled.

The project for saving the High Yard Works of J. Spencer & Sons, Newburn-on-Tyne, has resulted in failure, and we learn that the necessary financial aid is not forthcoming. Messrs. Thos. W. Ward, Limited, purchased the Works three months ago, but have delayed dismantling operations in response to the appeal made by the Local Committee and others. Now all hopes of running the Works are extinguished, and the well-eqipped steel foundry, forge, engineering and spring shops will be dismantled and the plant utilised in other parts of the country. The people of Newburn are now hoping that the freehold site of 60 acres, with its extensive buildings, railway sidings and frontage to the river Tyne will attract some new industry which will not only find work for the unemployed workmen, but also bring prosperity back to the village.

Indian Locomotives for England.

Since the war, Thos. W. Ward, Limited, have made many interesting purchases of works and plant in Great Britain and abroad, and they have now extended their operations to India, where 16 British-made modern locomotives have been purchased. The locomotives, which are standard gauge of the 4-wheel coupled saddle-tank type, have been purchased from the Bombay Improvement Trust. Bombay is more or less situated on an island, and soil has been taken from one part and dumped in another for reclamation of land purposes, and the locomotives have been used for this work. Their work now being finished, the locomotives are to be brought back to England for further use.

International Foundry Trades' Exhibition.

A representative of the International Foundry Trades' Exhibition will be visiting Birmingham, Wolverhampton, Dudley, and other Midland centres during the week beginning February 18. Anyone interested in receiving particulars of the Exhibition should make an appointment, which may be arranged by writing to the Organisers, 4, Vernon Place, Southampton Row, London, W.C.1.

BY THE PASSING of Mr. John Hudson, of Normanton, the foundry industry has lost one of its best-known men. The deceased was with the firm of Messrs. Leys Malleable Castings Company, Limited, of Derby, for 34 years prior to his retirement.

MR. E. R. TAYLOR, A.R.S.M., D.I.C., F.I.C., has been appointed Lecturer in Metallurgy at the Central Technical College, Birmingham. Mr. Taylor was engaged by the British Cast Iron Research Association as part-time investigator in August, 1924, and became a full-time investigator in January, 1926, specialising in malleable cast iron. During 1925-1926 and 1926-1927 he held Carnegie Scholarships given by the Iron and Steel Institute, and his contributions relating to the influence of sulphur and manganese in malleable iron appear in the Carnegie Scholarship Memoirs. Mr. Taylor now returns as lecturer to the Metallurgical Department of the Central Technical College, at which he was formerly assistant lecturer. This department is directed by Dr. F. Johnson, whose contributions to metallurgical literature are well known.

Foundry Purchasing.—XXXII.

By Eric N. Simons.

Dealing with Scrap.

Scrap is dealt with in the following manner:—When a sufficient amount has been collected, the buying department finds a buyer and notifies the stores. The scrap is then loaded up, and the character and weight are noted down on triplicate forms (Fig. 1). Of these, one is sent to the buyer, another is forwarded to the accounting department, and the third is retained for reference by the stores department. The copy received by the accounting department enables them to credit the department which has provided the scrap with the amount received in payment. This procedure, again, is to ensure proper costing. A similar procedure is adopted for goods sent out to be repaired. The first copy of the form—identical with that shown in Fig. 1—is sent to the repairer;

STORES DEPT.

.....192....

To.....

Please receive as under: DEBIT SYMB.

cwts. qrs. lbs.

Signature.

From Dept. CREDIT SYMB.

Fig. 1.—Stores Scrap Delivered Note.

the second goes to the accounting department to enable the department to which the goods belong to be debited with the cost of repairs; and the third is retained for reference.

A careful perusal of the foregoing notes will have given the reader a good idea of the detail work carried out by a general stores in a firm of fair size, and will also serve as a guide to the systematic procedure to be adopted. One must now turn to the more general aspects of storing goods.

Protecting Goods from Pilferage.

One of the most important functions of the storekeeper is to protect the goods in his keeping from theft, and from deterioration of an avoidable or reducible kind. While it is easy to lock up small objects in lockers and so forth, there are materials in the stores building that cannot so easily be disposed of; for example, bolts and nuts, rubber tubing, emery wheels, and so forth, might be mentioned. Furthermore, the stores clerks cannot be running here, there and everywhere with keys, unlocking this and that. The speed with which their work has to be done precludes this. The poblem resolves itself, therefore, into one of preserving the stores building itself from the intrusion of unauthorised persons and of providing proper storage receptacles for the goods to be kept. Naturally, it is impossible and not specially necessary to describe in detail every kind of receptacle that can be used for every kind of commodity. No buyer or potential buyer, no storekeeper or potential storekeeper, needs to be told what sort of bins, racks, shelves, lockers, boxes, drawers, and so forth he must use. If he has certain goods to stock, he will need little instruction in the work of preparing receptacles for them. One night, however, mention one standard fixture of value, which is a stack of iron lockers, 7 ft. or 8 ft. high, consisting of iron plates bolted together and forming receptacles roughly 2 ft. 6 in. wide by 2 ft. in height, and about 18 in. from front to back. The appearance of a stack of this sort is rather like that of an egg-box standing on end. Lockers of the kind can be used for the storage of a good many smaller commodities, such as bolts, nuts, brushes and nails.

Arranging the Goods in the Storeroom.

On the arrangement of goods within the stores a few essential conditions should be observed. Goods required at frequent intervals should be placed where access to them is convenient and easy for the stores clerks. Heavy commodities should be placed so that they can be loaded into barrows, trolleys, and similar conveyances with the minimum of effort. The spaces or lanes between the stacks of shelves or racks should be fairly wide, so that the stores' officials when fetching goods, or when taking stock, shall have adequate light. If the lanes are too narrow, the shadows of the stacks obscure the light. Furthermore, narrow lanes make for cramped working and difficulty in removing goods quickly. It is always a good plan to have shelves and racks wider at the bottom than at the top, so that a side elevation would show them as almost triangular. This makes for better illumination and easier working, without any diminution of storage-room. One plan adopted in the United States has advantages, though it takes up more room than can usually be afforded. It is to have duplicate bins, or, in other words, bins that extend through from one aisle or lane to the next. Fresh material is put in one side, and issued material is taken out from the other. Thus, the goods that have been longest in stock are those first issued. This method is specially valuable where goods are apt to deteriorate progressively.

Auxiliary Stores.

While it is preferable to keep all goods in the general stores, many large establishments will find it necessary to have auxiliary stock-rooms near to certain producing departments. The reason for this is that the time required for men to go backwards and forwards to fetch tools, etc., from the general stores would prove a serious handicap to rapid production. At the same time, the establishment of auxiliary stores must not be assumed to connote the institution simultaneously of separate stores, records and systems. The general stores will keep all the detailed records, and will merely issue goods to an auxiliary stores as to a separate department. The auxiliary stores will keep a record, of course, of the goods it issues, but these records will go to the general stores for examination and check, and will not need special incorporation in the general records, since this incorporation took place at the time the goods were first issued to the auxiliary store.

Some goods, such as pig-iron, timber, and so forth, may need to be stored in the open, on convenient sites; but this should not prevent their inclusion in the stores records.

Issuing Goods from the Stores.

The issuing of commodities is very nearly as important from the point of view of efficient storekeeping as the actual storage. In a previous article, the necessity of ensuring that only authorised officials or foremen sign the requisition dockets has been indicated. Only thus can pilfering be prevented. Requisition dockets should state clearly the precise quantity needed, the size, and whatever other information is needed, to enable the storekeeper to issue the right goods quickly. In the instances described previously, the department issuing the docket is indicated by an alphabetical symbol for costing purposes. In other instances, this information is supplied to the storekeeper by means of variations in the colour of the docket. Thus, Department A might use a green docket, Department B a grey docket, and so forth. This latter method is principally suitable for small firms that do not possess a large number of differing cost accounts.

Another variation on the method outlined is to make the requisition docket more important, the object being to prevent any possibility of fraud on the part of either the foreman or the storekeeper. This variation consists of triplicate requisition books. One copy, the original, is sent by the issuing official to the stores. The second copy goes to the buying department, the third being retained by the foreman. When the goods have been issued and signed for, and the original docket has been used for stock-recording purposes in the stores, it follows the second copy to the buying department. Here they are compared, and any discrepancy is at once perceived. To facilitate work of this kind, requisition dockets should be numbered consecutively.

Scots Iron Workers' Dispute.

On January 28 1,500 men employed by wrought-iron manufacturers in Lanarkshire came out on strike because the employers proposed new conditions, which in the opinion of the men meant that they would have their working week increased from 40 to 47½ hours without extra payment. It was stated by an official of the Iron and Steel Trades Confederation that a withdrawal of labour had been decided upon as a protest against the employers refusal to settle all disputes through the Conciliation and Arbitration Board. The employers withdrew from the Board four weeks ago, and their notices terminating the existing wage contracts with the employees terminated on January 26.

Interest in the dispute is national, as this industry is held to have been the first to have conciliation machinery. "There is talk of peace in industry at present, yet here is an instance of how conciliation works in an industry that has had an arbitration board for almost 40 years," remarked an official of the Confederation. "That is why the dispute is of national interest." The same official said that the disputed point was not the 48-hours' week, but the eight-hours' day. The employers proposal for a five-day week of 47½ hours meant a 9½-hours' day, which was 1½ hours longer than the eight hours recognised by employers and workers throughout the iron and steel industry.

So far the dispute is not affecting Motherwell. The principal works there, where 500 men would have been affected, has an arrangement with the Confederation, and there is no stoppage. In Wishaw two works are affected by the dispute.

It is understood that the employers demand an extra heat per shift from the puddling furnaces, and this the men say is not possible. One or two of the employers frankly admit that it is doubtful if the extra heat could be obtained.

It is stated by the employers that the production of wrought iron in Scotland, which in pre-war years was 200,000 to 250,000 tons per annum, and in 1920 was 173,000 tons, declined in 1927 to 60,000 tons and in 1928 to 47,000 tons and that the position is therefore a critical one.

Grinding Machinery.

A lecture on "Grinding and Grinding Machinery," under the Louden Lectureship in Engineering, was given by Mr. Kenneth M. Sloan in Glasgow University on January 30. The important advances recently made in grinding as a manufacturing process were discussed, and the comparative values of cylindrical and surface grinding, as compared with planing and turning methods were illustrated by recent tests on the stock removing capacity of the different processes.

Refractory Materials.*

By W. R. D. Jones.

A material is termed refractory when it will resist exposure to high temperatures without softening, but from a commercial point of view this definition must be narrowed down to include "under the prevailing conditions." For example, silica is a very refractory material, and will withstand almost any heat which can be obtained commercially, but in the presence of a basis material such as lime its refractoriness is lost entirely, and the silica becomes a flux which, as is well known, causes a relatively low melting slag. Therefore "refractoriness" alone is no criterion for the satisfactory service of a furnace lining, whether it be made of bricks or a rammed lining.

Classification of Refractories.

For the sake of convenience, the commoner and well-known refractories are classified into the acid type, which include silica in its many varieties, neutral, the chief of which is fireclay, and basic, most of which are magnesite and dolomite. Modern developments in most industrial operations tend to the use of higher temperatures, and, as a consequence, there has been introduced a class of refractories termed "super refractories." This class absorbs about 5 per cent. of the total refractories in use, and for the special purposes for which they were introduced have proved excellent. Amongst them should be noted sillimanite, chromite, graphite, carborundum, aloxite, alundum and zirconia. However, with greater care in the selection of raw materials, in manufacture and the correct use of refractories, many of the commoner refractories can be so improved that they can be made as useful as some of the "super" refractories.

A Neglected Aspect.

A general property of refractory materials which deserves more attention is that of texture or the grain compactness as a whole. The properties of refractory bricks, especially those made from silica materials, have been shown to depend to such an extent upon the grading of the raw materials, and hence the texture of the finished lining (whether rammed or made from bricks), that the texture of the lining in any particular part of a furnace should be varied to suit the particular conditions prevailing in that part. Briefly, a coarse-textured lining will have a relatively high refractoriness, a greater resistance to sudden and extreme alterations of temperature, also resistance to slag attack, a lower crushing strength, and in the case of bricks will require a longer kilning period than a close-textured lining. It is noticed that some of these properties are combative. For example, in the melting zone of a cupola there is not only the highest temperature, but the greatest slag attack, and the spalling effect is apt to be severe. Consequently, one property has to be sacrificed for the sake of the others, as it is not possible to have a lining which will specialise in resisting all three factors. Great care is therefore needed before selecting finally the best type of lining.

Acid Materials.

The acid refractory materials have silica as their chief constituent. The type of silica most in use is quartz—a crystalline variety known as flint was used extensively. Quartz occurs in a very pure form suitable for making either bricks or the chief part of a rammed lining, in South Wales, at Craig-y-dinas, near Hirwaun, being part of the millstone grit series, and in the Sheffield district, underlying the Halifax hard bed coal. The former rock was manufactured into "Dinas" bricks by Weston in 1822, whilst the latter was made into "Ganister" bricks. Every type of pure quartz rock is not suitable for the manufacture of bricks, but these two possess those essential characteristics which make them so valuable. They are very similar in structure and refractoriness, the chief difference being that the ganister has a higher percentage amount of oxide of aluminium. This higher amount of alumina in most cases enables bricks to be made from ganister without the admixture of a bonding reagent, whereas the higher percentage of quartz in the Dinas stone requires a bond such as 1 to 2 per cent. lime, since quartz is devoid of all plasticity. So firmly established have these two materials become that although the source of their origin is definite yet bricks made from similar materials found in other parts have been given the names "dinas" and "ganister." For example, in South Wales the same firm mine what they call (*a*) dinas or silica stone, and (*b*) ganister. Their analyses are as follow:—Silica stone: SiO_2, 97.3; Al_2O_3, 1.0; FeO, 0.8; CaO, 0.2; alkalies, 0.08; MgO, 0.2 per cent. Ganister: SiO_2, 93.5; Al_2O_3, 4.0; FeO, 0.7; CaO, 0.35; alkalies, 0.40; MgO, 0.05 per cent.

As quartz is the chief constituent of silica or ganister bricks, the effect of heat on quartz is important. Apart from a temporary expansion of these bricks on heating, which is similar to the increase of length of a bar of metal on becoming hot, which then reverts to its original size on cooling, there is a permanent expansion generally known as the "after expansion," which is not reversible. It is this permanent expansion which is so important, because if the maximum amount of permanent expansion does not take place during the burning of the green or raw brick in the kiln, it will take place during the service of the brick, and cause great pressures to be induced which will cause obviously a strong tendency of the brick wall to buckle and collapse, especially if the bricks form the roof of a furnace. It is not a commercial proposition to obtain the whole theoretical amount of permanent expansion during the kilning, but after about 75 to 80 per cent. of the possible expansion has been obtained during the burning the remaining expansion takes place with such extreme slowness and needs such high temperatures that ordinary precautions and the intelligent use of tie rods during practice is sufficient to prevent damage. If a rammed lining contains a large amount of quartz grains, the necessity for slow drying and a slow heating-up for the first heat is at once apparent if serious cracks are not to develop, since the furnace has to act also as the burning kiln. This permanent expansion is due to the silica of the quartz changing into a form with a lower density. This change takes place more rapidly, the finer the texture, the greater the impurity or non-siliceous matter, the longer the material is exposed to the burning temperature. American practice favours the maximum amount of change taking place in the kiln by a lengthy burning at a temperature of 1,650 deg. C. and the use of less pure materials, whereas British practice has favoured less change taking place by using materials of greater purity and larger grain size, together with a slightly decreased burning temperature. It is necessary to emphasise this point because many bricks in this country need to have more of this permanent change taking place in the kiln.

Use of Neutral Refractories.

Silica refractories have the great advantage of being strong at a high temperature and of being resistant to slags and to metallic oxides other than lime. A parting layer of a neutral refractory material is necessary to separate a dolomite hearth from a silica superstructure, but it is not so necessary when a magnesite hearth is used, as the lime content is very low. Lime and silica form readily a very fluid and low-melting slag—calcium silicate. Further, lime mortar must never be used to set the bricks. On the other hand, probably the greatest disadvantage of silica refractories is their strong tendency to spall on rapid and extreme fluctuations of temperature. Silica is almost as bad as magnesite in this respect, but the fact is not recognised sufficiently. Elaborate precautions are always taken to guard against spalling when cooling down a furnace lined with magnesite, whereas a furnace lined with silica is allowed to cool down uncontrolled—no special care being taken—and as a consequence spalling is highly developed. Very often cupolas are cooled from a high melting temperature to an ordinary temperature and back up again between two working days. Silica bricks of good quality will not withstand this rapid and wide alteration of temperature, and are therefore not recommended for lining cupolas. If the cupola were worked continuously at high pressure then silica bricks would prove superior to many of the fire-clay bricks in use.

Fireclays.

The next most important refractory material are fireclays. They possess a very high degree of refractoriness and have the added advantage of being plastic, and, a fireclay rock being much softer than silica or ganister, bricks made from fireclay are much more easily manufactured and of much less cost. However, the term fireclay is so wide, and they vary so much in composition, that they are being replaced in many processes by silica bricks, *e.g.*, coke-oven practice, gas-works practice, etc.

True clay—which is white burning—may be taken as kaolin containing 40 per cent. alumina. Fireclays are considered conveniently as mixtures of kaolin and silica, so that as many of the commercial fireclays contain only 25 to 30 per cent. alumina these refractories are not strictly neutral, but occupy a position between the more-markedly acid silica and the neutral kaolin. On burning, kaolin undergoes changes, just as quartz does, but the changes result in a permanent contraction which manifests itself in the fireclay refractories. On prolonged burning, or after long use, the kaolin has changed into minerals called sillimanite (63 per cent. alumina) and mullite (72 per cent. alumina). These materials occur naturally, and sillimanite is now rapidly becoming recognised as an important refractory material, and is imported in large quantities from India. It has found great use in the glass industries and obviously, when a refractory material "starts" where a good quartz fireclay "finishes" it is well worthy of consideration from the foundry point of view. Compared with fireclay, it has the disadvantages of being non-plastic, heavier, requiring higher burning temperature to produce good bricks and greater cost at present. Its advantages are its smaller drying and firing shrinkage, much greater refractoriness, greater resistance to spalling, and by suitable admixture with ball clay of being made into very strong refractory articles. Mullite has not, as yet, found much application in industry.

Evaluation of Fireclay.

In judging the merits of a fireclay, it is necessary to note that the main constituents are silica and alumina, and it is convenient to consider the whole of the alumina as combined with silica to form the clay substance or kaolin. The silica over that amount is present as quartz. In ordinary fireclays the silica varies from 50 to 80 per cent. and the alumina from 35 to 10 per cent. The other constituents may be treated as impurities, as they act as fluxes and lower the refractoriness. There is little difference between the refractoriness of silica (quartz) and pure clay (kaolin), but if either is added to the other there is an appreciable decrease in the softening temperature so that the materials, clayey sands and sandy clays, so much used in foundry work, will have relatively low refractoriness, and when, say, about 20 per cent. of clay has been added to a silica or ganister the durability from a cupola standpoint is open to suspicion. Patching materials which are used to such a large extent in bricked cupola linings for replacing worn parts are often given the name "ganister." This is a misnomer, and covers a large variety of materials, some of which have no true ganister at all. The patching must be fairly plastic to stick easily to the cupola side, and it must be refractory so that it is necessary to have a mixture of clay (to give the plasticity) and silica sand, but care must be taken to have the minimum amount possible of clay, so that the patching shall not be much less refractory than the lining itself. Grinding fireclay with silica stone

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* A Paper given before the Wales and Monmouth Branch of the I.B.F. at the University College of South Wales and Monmouth, Cardiff, Mr. Ben Hird presiding.

or ganister is destroying the very properties required, and it is by far the better plan to start with the ganister and grind it with a small amount of pure clay, which will give a mixture which will just stay in place when daubed on the worn part—never forgetting that it is a patch after all. True ganister is practically non-plastic, and therefore every "ganister" material which is plastic must be viewed with a great deal of suspicion. Shake a little of the preparation in a tumbler of water and compare the amounts of silt (clay) and sand (silica).

Bricks made from fireclay are used in preference to silica bricks wherever possible, owing to their lower cost and when the furnace temperatures fluctuate, as they resist sudden and extreme variations of temperature better, and where the working temperature is not high fireclay bricks are much more suitable than silica bricks for lining cupolas. There is, nowadays, a general tendency to replace fireclay by silica for gas works, retorts and coke-oven bricks. The change has been adopted on a wide scale in America. Really, silica bricks and high quality fireclay bricks are complementary, as each variety is more suited for certain particular purposes. One of the main reasons for the replacement of fireclay bricks by silica bricks in American coke-oven practice is the ability of the latter to carry heavy loads at high temperatures, and not merely because they have a higher thermal-conductivity, or are more refractory, or are able to withstand better the corrosive action of salty coals.

Foundry Sands.

Several excellent accounts of foundry sands have appeared within the last few years in THE FOUNDRY TRADE JOURNAL. Silica sands used for cores and for mixing with strongly bonded moulding sands should be pure, and, to ensure maximum permeability, should have rounded grains of not more than two sizes, one relatively large and one smaller, and should be as free from silt as possible. Moulding sands should be high in silica, but must also possess a good bonding agent. An iron-oxide bonding agent is better than clay, since it is not so readily "spent." To ensure that the bond is spread evenly over the silica grains thorough and efficient milling is necessary. To attain uniformity of output in the foundry there must be a regular and consistent supply of the same material. The mortar sands used for jointing should have a composition as near as is possible to that of bricks. More care than is generally given to laying bricks is necessary, since the joints are always sources of weakness.

Jointing Brickwork.

Even when using the same materials as that of bricks, the finer grinding necessary to prepare the mortar causes a lowering of the refractoriness and a greater susceptibility to penetration by slag due not merely to the finer grade, but also to the cracks caused on drying and shrinking from the action of heat allowing slag to percolate, and thus opening up the joint and causing a fluxing action behind the face of the brick and greatly lowering the efficiency of the wall. Consequently the joints should be as thin as possible. To ensure this, bricks must be true to size and possess well-defined edges. Any spaces left should not be filled with the mortar but by a "concrete" of pieces of the brick material bound with a small amount of the mortar. The consistency of the mortar should be that of cream which must be squeezed out when laying the bricks so that the joint shall be as thin as possible. About 8 cwt. of mortar is sufficient for a thousand bricks. For jointing silica bricks, ground silica (which is not plastic) should be made plastic with the addition either naturally or artificially of as small amounts as possible of clay. It is best to use a selected natural sand, for in no artificial mixture are the non-plastic grains coated so uniformly. Although some of the naturally occurring local sand-mixtures vary greatly in composition and properties it is possible by either washing or fine grinding with small additions of high-quality pure silver sands to produce an efficient mortar. Finally, it is not at all necessary to import foreign sands for any purpose, since there are plentiful resources of all types of sands in this country.

Lining Cupolas.

There are two methods of lining a cupola: (1) bricking and patching; (2) ramming or the production of a monolithic or single piece lining. The monolithic lining is finding much favour just now in the Midlands because chiefly there are no joints as with a brick lining. If, however, bricks are chosen carefully in respect to shape and a correct mortar is used, the jointing trouble is not so serious. The monolithic lining is made by ramming carefully the prepared mixture between the shell of the cupola and a wooden circular block of the same size as that of the internal diameter of the cupola. Provided due care is taken in ramming and only about 4 to 5 in. is rammed at a time, very satisfactory linings are produced and repairs can be quickly carried out by using the ramming material as a patching, and the fettled patch becomes, if properly made, a part of the wall. Great care must, however, be taken to avoid cracks due to volume changes, which may be formed during the drying and first firing since the cupola must act as a kiln. Therefore, the drying out and heating to the working temperature must be carried out as slowly and evenly as possible. A further disadvantage of a rammed lining is that as only part of the wall is exposed to high temperatures the front face may be thoroughly sintered and baked by the heat, whilst the inner parts nearer the shell are soft. Rammed linings have certainly proved very successful, but arguments for replacing bricked linings must depend on circumstances. When a lining requires many special shapes, which are necessary and expensive in bricked linings, then a rammed lining offers special advantages.

Speaking generally, the ramming material should be of the nature of an ordinary concrete mix—relatively large pieces of quartz rock—ganister or dinas, to resist the working temperature, set in a finer graded aggregate of the same rock mixed with just sufficient plastic fireclay to retain its shape after a hard ramming and stay in position until the lining is thoroughly baked. The amount of water used in mixing should be the least possible in order to minimise the volume changes on drying and burning. The finely-ground clay and silica then act as a cement for the larger pieces of quartz rock.

In the discussion which followed Mr. Jones told how he had tried some carborundum blocks for facing brickwork when a high temperature was required, and had found he could get as much as 1,750 to 1,800 deg. C. without injury, and at the same time the brickwork behind the carborundum had melted away entirely. It would be possible to use carborundum bricks at the melting zone of cupolas, but he could not speak of their commercial effect. Sillimanite bricks would probably prove very satisfactory at the melting zone of the cupola since they were very refractory and resistant to slag.

Patent Specifications Accepted.

The following list of Patent Specifications accepted has been taken from the "Illustrated Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The last numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

26,863. PHILLIPS, W. H., and DAVIES, W. Manufacture of tinplates. 303,846.

27,287. STANDARD TELEPHONES & CABLES, LIMITED (Western Electric Company, Incorporated). Wire-drawing machines. 303,925.

248. CENTRIFUGAL CASTINGS, LIMITED, HURST, J. E., and BALL, E. B. Centrifugal machines for casting metal pipes, etc. 304,015.

9,661. COMPAGNIE DES METAUX OVER-PELT-LOMMEL. Apparatus for roasting and/or sintering ores, etc. 294,197.

19,145. CAMPBELL, D. F., and ELECTRIC FURNACE COMPANY, LIMITED. Furnace linings. 303,574.

THE HASLAM FOUNDRY AND ENGINEERING COMPANY (1927), LIMITED, is being wound up voluntarily. Mr. H. C. Waddington, Trafalgar House, Waterloo Place, London, S.W.1, is the liquidator.

The Continental Steel Trust.

On various recent occasions it has been hinted in influential but non-official German circles that the German group in the Continental Steel Trust will not continue its membership when the time arrives for giving six months' notice to determine the present agreement, unless satisfaction is given to the claims put forward for the alleviation of the burdens imposed on the German works under the agreement. In this connection attention may be directed to a communication published in a Frankfort paper by a Paris correspondent, who is said to represent the views of the leading authorities in the Western groups (French, Belgian and Luxemburg).

This correspondent states that the German desires are obviously only known through third parties. Officially the German representatives have hitherto not made known that they are not in agreement with the general objects of the Trust, nor have they ever disputed the fact that the Trust, besides economic advantages, has also brought about political advantages, which view is shared by the other groups. It would be difficult to imagine that the German works would proceed to give notice before they had endeavoured to obtain a remedy for the anomalies complained of. For among the members of the Trust there is probably not one who does not at least admit in part the justness of the German complaints. A threat of giving notice in such a conciliatory atmosphere would be ill-advised, and, therefore, for the time being not expected. Quite interesting is the opinion that the other groups had not anticipated that the German excess of the quota would ever turn out so large, and lead to the payment of such heavy penalties. None of the members considered the provision of the common fund by a minority or by an individual member as an ideal. Recognition of this fact from the very beginning has led to a reduction of the penalty. Whether this can be further reduced, without losing its efficiency, must be doubted after the experience gained by the International Rail Makers' Association (Erma). The original rate of $4 per ton for the export trade could, perhaps, be reduced. But this would, beyond question, meet with a certain amount of opposition, taking everything into consideration.

Increase in German Quota?

An increase in the German quota would be of greater importance to the German industry. Such a claim will, the correspondent thinks, presumably be put forward by the German producers, and the other members will, it is believed, examine such a claim with goodwill and impartiality. It is, however, thought that dangers may arise, in so far that the German works will probably demand a much higher quota than they really hope to receive. In each group there are certain members who believe they have not received a fair share in their allotments, and in these cases an exaggerated German demand might be the occasion for raising difficulties again. The opinion, therefore, prevails that the German works will not put forward an exaggerated quota demand, this point always having been one of the most difficult matters in connection with syndicates.

The correspondent proceeds to state that it is not known whether the German works will insist as a *sine qua non* of their adhering to the Trust that international selling syndicates should be formed. In France the opinion is that the problem has in the meantime assumed another form. At the time of the deepest depression in the market, selling syndicates were considered as the most suitable method of improving selling prices, and re-establishing remunerative working. But now, when, for instance, steel bars are £1 10s. higher than they were about 14 months ago, and export prices have to some extent become profitable, the disposition to form selling syndicates has greatly decreased, even among former advocates of such syndicates. Certain products, as, for instance, rolled joists, the prices of which are, relatively speaking, far below those of bars, would be able to bear some increase, but, on the whole, makers can very well manage with the present prices. Apart from this instance, selling syndicates would scarcely have a further stimulating effect on prices. In the circumstances the majority of the members of the Trust are not in favour of the immediate formation of selling syndicates, but will defer this stage until the time when a fall in prices threatens again. If the German works were to insist on the setting up of selling syndicates as one of the conditions of their remaining in the Trust they would probably meet with failure, which might prejudice the idea of selling syndicates in general.

The next meeting of the Trust is to take place in Luxemburg on March 14.

Symposium on Steel Castings.

AUTHOR'S REPLIES.

(*Continued from page 74*).

MR. JOSEPH JEFFERSON wished to make it quite clear that any remarks he made were not intended to belittle the objects of the meetings—that was to get better castings—as for the last 35 years that had been his main object in life, and there was still room for much improvement. With regard to Engineer-Commander Sidgwick's remarks, he thought that if there had been a visitor present, a man unconnected with the engineering or the foundry trade, when Commander Sidgwick gave his address, he would have thought that the steel-founding industry must be in a very parlous state. When one considered the small number of failures which actually occurred, he did not think the conditions were as bad as the visitor would have expected. Considering the requirements of the ordinary user, and after all, with all due deference to the Admiralty, the ordinary user was the man who took the bulk of the products—the Admiralty may be the largest individual consumer, but the general market took a very much greater amount than the Admiralty—if the ordinary user was buying a casting and there was a certain proportion of it, say, 10 per cent., of the section which could not be fed properly, that 10 per cent. would give a lower tonnage than the other part of the casting. This would probably be fed, and might cost, say, 10s. per cwt. more. If the area is increased one-twentieth, then a casting was obtained which would be as strong as if it were fully fed, and the extra expense of that was 4½d. per cwt. That is 4½d. against 10s. The ordinary consumer would generally prefer the former: Foundry people were out to give the consumer the casting for which he was prepared to pay, and this might account for certain castings not being made as well as they might be.

Engineer-Commander Sidgwick gave a most interesting example, where he was able to save weight by having what was formerly made in steel made in cast-iron. If he would be kind enough to give a sketch of this casting, no doubt it would give his listeners something to think about, and he (Mr. Jefferson) would feel humiliated if the design was such that it could not be made as a steel casting.

Difficult Steel Castings.

ENGINEER-COMMANDER SIDGWICK then sketched on the blackboard three examples, reproduced in Figs. C, D and E.

MR. JEFFERSON, continuing, said from the nature of the casting shown in Fig. C there was no particular reason why a hole should be present, but in all castings there were occasionally holes of that character, no matter what the nature of the metal was, and one could not explain them.

The second one (Fig. D) appeared to be part of a double-shelled valve, the inner part being connected to the outer by ribs which were thinner than the inner shell. The only method of feeding the latter was through the thin connecting ribs, and as the steel in these will set before the inner shell this could not be fed, and hence the defect was a question of design.

In the case of the cylinder (Fig. E), it was a foundry fault. The head was probably put at A.B., and the part below the head set before the bigger mass in the vicinity of the drawn hole, and thus the head was unable to feed the heavier section. The feeding head should have been placed as the dotted lines.

With regard to Dr. Pullin's remarks, he (the Speaker) was sure that it would be of interest to engineers and founders alike to have some idea of the cost of X-ray plant to examine up to, say, thicknesses of 3 in., and also the cost of upkeep and cost per print. Dr. Pullin suggested that in the case of a new design of a standard article it should be X-rayed. The next best thing was to cut up a casting before proceeding with the bulk. One must not overlook that only comparatively large defects can be detected by the X-rays, say, one-tenth of an inch in steel 3 in. thick, whereas under the microscope one can detect defects which it would be impossible to see by the X-rays, and often a failure had its origin in these microscopic defects. He asked Dr. Pullin if X-ray examination indicated a part that was underfed. If this part was machined it would look perfectly sound, but a tensile test taken from it would either give lower elongation than normal or lower tonnage.

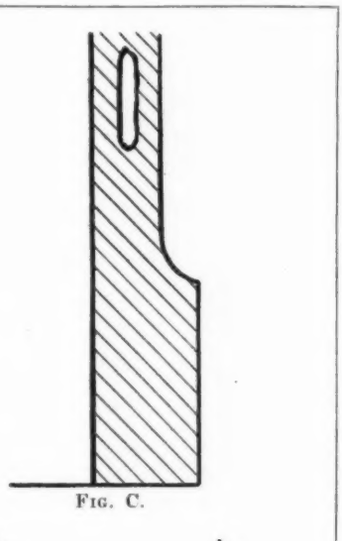

FIG. C.

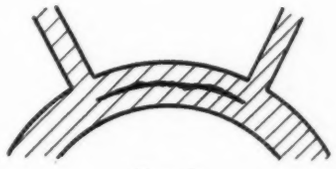

FIG. D.

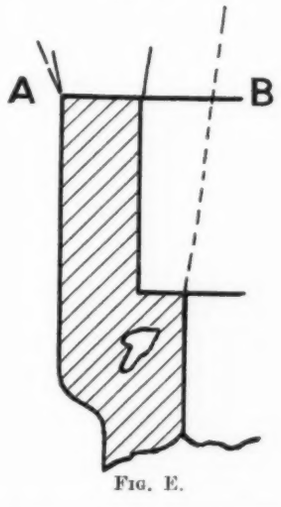

FIG. E.

If he understood Dr. Pullin correctly, he gathered with regard to a certain casting which had been examined by X-rays that after that casting had been at the annealing temperature for a sufficiently long time, it was actually as badly stressed as when it was cast. He wondered if this could be indicated by mechanical tests, and he was sure the members would be grateful if Dr. Pullin could give them a sketch of the casting, so that they would know the type to be avoided.

Mr. Brown mentioned several cases where people went for castings to the Continent. Was it not true that generally the attraction of the Continent was cost? If one took a casting costing 40s., the steel part only represented 8s., leaving 32s. for other expenses. Most of that was in wages. The foundry workers in Belgium get about half the wages obtained here, so, naturally, one could purchase a cheaper casting from there. Mr. Brown suggested that the advantage might be by their using the electric furnace. There is a steel foundry at Leven using the electric furnace, and they specialise in motor castings, and are turning out perfect work, but he had yet to learn they were working at full capacity, and this not on account of quality, but simply because the motor trade could buy cheaper from the Continent.

He thought Mr. Adam must have misunderstood him, for he took him to say that test pieces in no way represent strength of a casting. That was not what he intended to convey. What he intended was, that where it was a complex casting if it could be fed properly, then there were areas in that casting which did not give as good a test as the test bar, but the bulk of the casting would give as good a test as the test bar. The hammering test could not be relied upon, as an anchor head, although half cracked through the arm, has, when hammered, rung like a bell.

He did not agree with Mr. Lewis on the question of the patternmaker, because the patternmaker was entirely dependent on the designer. The patternmaker can only make a pattern which would produce a casting the same as the drawing shows, but the patternmaker's art was such that he could make it easier for the moulder to produce the casting.

Mr. Hudson's sections of valves were interesting, and the one that was good was expected to be so, because the area of the section was gradually reduced all the way to the thin section. There was no restricted part to affect the feeding from the head. Mr. Hudson apparently misunderstood his remarks about blow-holes. He suggested that the customer gave the founder the type of defect, not the cause of the defect, for the latter was obviously the foundryman's duty.

Mr. Currie suggested that it might assist founders if engineers worked to one specification, say, 34 to 38 tons with 15 per cent. elongation. This would be a retrograde step, and could not meet present-day requirements. There were highly-stressed parts of turbines which could not be made strong enough from such a steel, and, again, the question of wear had to be considered; in some cases such a steel would give a relatively short life.

The X-Ray Situation.

DR. V. E. PULLIN, in a general reply, pointed out that the National Physical Laboratory at Teddington, as far as he knew, was not doing any research work whatever on the investigation of steel castings for flaws, as they had no apparatus for the purpose. What they were doing was some work on the crystal analyses of steel and crystal analyses of metals. That was work that was also being done at Woolwich, though perhaps there they were doing it more especially from a Service point of view than from the more general or commercial aspect. X-ray research was now tending to eliminate photographic methods. It is perfectly clear that the practical utility of the X-ray in the examination of castings for flaws and defects would be very largely confined initially to comparatively thin specimens. The amount of ordinary inspection work the X-rays would do on steel castings within a thickness of, say, 1¼-in. of wall thickness, is very large, and he did not think that he was too optimistic when he said that the time was not far distant when we should be able to do all such inspection work by visual methods. As a practical proposition in the laboratory, one could visualise steel castings up to a thickness of 1¼ in., and he thought that with a little more power and the development of technique and optical systems with which he was now experimenting, he would be able to make examinations up to 1½ in. a matter of practical politics. It was certainly a practical proposition. That brought him to the question that Mr. Jefferson raised concerning cost. The cost of the X-ray equipment was really to be expressed

chiefly as capital cost. The running cost is low, and the depreciation is not high. The average life of the X-ray tube might be five years, with good care, so that the cost of running an X-ray equipment ought not to be high. Of course, if one used photographic apparatus it was higher. The cost of a film was about ½d. a sq. in., including the cost of development. He emphasised the benefit of the use of X-rays in close collaboration with the foundry immediately after a batch of castings had been produced. The great advantage of X-ray examination was that one examined the specimen to see if there were any flaws in it without cutting it up, and therefore one did not injure your specimen in any way. He had practical experience of cases where good castings had been produced very largely as the result of the founder seeing and understanding X-ray pictures immediately the casting was produced. Mr. Jefferson raised another point, that of the production of strains, but in that case he was not referring to castings, but rather to preferential orientation in steel at various stages of annealing. Metallurgists know perfectly well how ordinary steel was oriented after rolling, and they know the effect of annealing at various temperatures in the elimination of the orientation that is produced in an ordinary piece of rolled steel. What he wished to convey, was that this orientation had a different pattern in three directions—one parallel to the direction of rolling, another a transverse direction, and another in the normal direction. It was curious that although by annealing one might remove this preferential orientation in one or two directions, yet it may not be removed in another direction. He mentioned this as a point of interest concerning the result of radiological research on steel generally, but not particularly with regard to castings. That was work that more properly comes under the heading of spectrum analysis, which was an entirely different thing from the ordinary inspection for defects, for blowholes and cracks and so on. In reply to Mr. Jefferson again, it was a very fair statement to make that the X-rays could detect any cavity or change of density in any metallic specimen if it is 3 per cent. of the total thickness. That was a general statement. He had previously said that an X-ray picture was a shadow. All that one saw was the result of X-ray absorption in the specimen, so that it was perfectly clear that if a piece of metal was cracked with the two sides of the crack definitely touching each other and the rays were coming down in the plane of the rays—one would see it best when the crack was at right angles to the rays, the absorption due to the minute air space would not be sufficient to show itself on the specimen. Even if the crack was small and in the plane of the rays, however, it would show up in the radiograph. Mr. West referred to steel having diverse physical properties. That is a matter again that metallurgists did not know very much about, but it was at present being investigated, including the method incorporating spectrum analysis. He assured Mr. West that that particular question was receiving attention, both from Dr. Moore, and in his own laboratory. He would like to thank Commander Sidgwick for the very clear way in which he emphasised quality. After all, it was apparent that the very essence of the matter was to produce high quality. Surely it should not be a matter of cost? Founders should not admit that they had to produce an inferior article simply because people would not pay for a good one. It might be a practical point, but the purpose of such discussions as these was to eliminate troubles in order to improve quality. The prime necessity above all other considerations should be quality, and such a conference as this ought to emphasise that point very strongly.

Research at Woolwich.

Engineer-Commander Sidgwick said he asked in his original remarks what was the limit of thinness in steel castings, but received no answer, and he did not expect one. Instead, all the speakers have emphasised the need for co-operation. Mr. Service's samples of valves on the table emphasises it even more. Mr. Service could have rendered no greater service to him than to draw attention to the need for co-operation between the designer and the other parties interested in the production of steel castings.

He was immensely struck by the remarks made by the new President of the Scottish Branch of the Institute of British Foundrymen in his inaugural address, as these had a good deal of constructive bearing upon this meeting. He (the President) referred to the inherited principles that had descended from generation to generation of founders, and remarked that in the production of any new casting there must essentially be a number of principles which must be adhered to pretty rigidly if success was to be obtained. He said that those principles could hardly be taught by book work, because they very largely depend upon manipulative processes and technique, which could hardly be replaced by mechanical methods of any kind. He, however, said that the great body of general principles could be written or spoken, and suggested that they should be made public by those best qualified to do so, namely, the moulders themselves. He endorsed that, and suggested that the Institute of British Foundrymen should produce a book of principles for the instruction of engineers, mechanics, and users, so that they might understand what demands they had made in their ignorance upon those fine craftsmen, the British foundrymen. If they knew something about it, then they might be able to save both time and money. That was his first suggestion, and, if all could get together in that way, they might be able to produce what he might call a natural casting, which should be more free from internal stresses than the unnatural one. Secondly, Mr. Longden stated that no good foundry foreman would set a man used to one type of castings to produce another type. That was, in effect, what was done when one firm was required to produce a large number of castings of very diverse form. Did it not suggest that an inquiry into the capabilities of the various producers of steel castings would be a good thing, because one would then be able to ascertain who could produce castings of A, B, C or D quality, and see that the orders went to the best people? It had been done, he understood, in forgings; why not in castings? If it entailed grading, still grading was done already to some extent, as there are firms on the Admiralty list for high-pressure, low-pressure, heavy and light castings. Something more extensive than this appeared necessary, and one must look to the founders to help in defining the grades.

As regards thinner and sounder castings, he thought it was quite evident that the practicability of their production was chiefly a question of demand. The user must demand right up to the existing limit of attainment, and the production of the castings should be entrusted only to those who were capable of making them. Other people, perhaps, would learn in time if they wished to.

As regards research, he understood that at Woolwich the pure research is being concentrated into attempting to understand the mechanism of "hot tearing," a phenomenon which must be very closely allied to the "creep," which occurred at lower temperatures; there were indications that these were both very closely connected with the purity of the metal. Such research must necessarily be very prolonged, and results would not be obtained to-morrow, or even in ten years' time, and meanwhile progress must be continued.

With regard to Mr. Jefferson's suggestion as to determining the limit of thinness of castings, in practice this could only be applied to castings which were suitable for mass production; the large castings, which were more or less individual, could hardly be susceptible to such treatment, and if one only applied it to the small castings the saving in weight would hardly be worth the expense.

British Columbia Iron and Steel Bounties.

A bill extending the existing bounty of 12s. a ton on pig iron which has been introduced in the British Columbia Legislature, offers a new bounty of 4s. per ton on steel shapes of commercial utility to plants having an annual capacity up to 20,000 tons. The maximum bounty on one plant is £4,000 a year. The total bounty payable on pig iron in a five-year period is £400,000.

Thomas Turner Medals.

Presidential Address.

At a gathering of friends of the Metallurgical Department, held in Birmingham University on January 23, the evening's programme opened with the presentation of the Thomas Turner Gold Medal to Professor H. C. H. Carpenter, F.R.S., by the Vice-Chancellor of the University, Sir Charles G. Robertson, M.A.; Professor D. Hanson, D.Sc., being in the chair. After the usual reading of the terms of the awarding of the medal, and the record of Professor T. Turner's services, which the medal commemorates, the Vice-Chancellor commented on the high standard already set by the previous recipients of the medal, and mentioned the names of Sir Robert Hadfield and Sir Gerrard Muntz. Continuing, the Vice-Chancellor expressed it as his opinion that this high standard would be still further raised by the admission of Professor Carpenter to this group, and he gave a record of the Professor's services and achievements, mentioning his work on the non-carbon diagram, and the growth of cast iron; the constitution of aluminium-copper alloys; the casting of bronze and rolling of aluminium sheet; and, finally, his work on large single metallic crystals. His services in connection with our great metallurgical societies and institutions were mentioned.

After the presentation Professor Carpenter paid a graceful tribute to his co-workers, the present Professor Edwards and Miss Elam, and then proceeded to give short review of the development of the Science of Metallography. This he divided into two sections, namely, the physico chemical and the crystallographic, both of which came into being at the beginning of the present century.

Dealing with the first the Professor pointed out the far-reaching importance of the practical application of the results obtained in the study of the constitution of alloys, and the connection between this constitution and the more recently studied lattice structure. Theories of deformation and slip were considered, both in connection with this and with the crystallographic section of the subject.

Dealing with the latter, the Professor described the process of growing large single crystals of aluminium and other metals, and gave some consideration to the peculiar mechanical properties of these, and the application of these results to our knowledge of the properties of metals as a whole.

Thomas Turner Bronze Medals were presented to Mr. A. E. W. Smith, B.Sc., of the Metallurgical Department of the University, and to Mr. H. W. Burrows, of the Birmingham Central Technical School, both being students of outstanding merit.

After the presentations the visitors spent a very enjoyable time examining the Metallurgical Department, where demonstrations by the staff and students were in progress. These illustrated admirably the facilities for instruction and experiment which the Department possesses, and special mention should be made of the new electro-plating laboratory, which has been brought right up to date through the generosity of the well-known firm Canning & Company, and contains, besides the usual plant, the latest equipment for chromium plating.

As usual the well-equipped technology laboratory, with its numerous types of furnaces attracted considerable attention—the visitors found much of interest in the other well-equipped laboratories, which are used both for instruction and research.

The various researches in progress in the Department were illustrated, and among these, special mention must be made of Professor Hanson's work on the flow of metals and the properties of large metallic crystals; and also on the iron-carbon-silicon alloys. The well-known research work on alloy cast iron which has been proceeding in this Department for some time was also well illustrated. Some of the exhibits were organised with the co-operation of the British Non-Ferrous Metals Research Association.

Potentialities of Alloy Cast Irons.*

LONDON MEETING CLARIFIES EXISTING POSITION.

The CHAIRMAN (Mr. J. W. Gardom) thanked Dr. Everest for emphasising the importance of an adequate price for castings, and particularly for having pointed out the necessity for educating engineers in this regard. Founders were being told continually—whatever the quality of the material they produced, and almost whatever delivery they gave—that the price was too high, and it was essential that engineers and buyers should be educated to a recognition of the fact that if they wanted the better quality material they must be prepared to pay adequately for it. In connection with the addition of other metals to cast iron, continued the Chairman, he was anxious to discover how to keep graphite entirely in solution until the metal was solid, and then to precipitate it.

Further Work Needed.

MR. J. E. HURST (Sheffield) wrote: I think that most of us are somewhat disappointed with the meagre nature of the so-called improvements shown in recent work on alloy additions. In this respect we are undergoing in a measure the experience of past investigators who have, like ourselves, seen the wonderful developments in the addition of alloys to steel, and have, naturally if unscientifically, expected similar results from the addition of alloys to cast iron. These circumstances appear to me to force you into a somewhat equivocal position. This is revealed at several places in your Paper. For example, in your conclusions you state that the improvement in hardness resulting from nickel addition is *often* accompanied by an improvement in strength.

What is of interest to us all is: Are the improvements accompanying the alloy addition greater than can be obtained without their addition? This requires demonstration, and, of necessity, will require demonstration under well-defined conditions.

In one place you express your opinion that the use of low-phosphorus iron is better for high-duty purposes. Under many of the circumstances which come within the ambit of "high-duty conditions" the use of low-phosphorus iron in itself goes a long way towards obtaining the desired properties. The danger of interpreting comparative tests, neglecting the phosphorus content is quite a real one in my experience.

Uniformity the Modern Criterion.

There is just one other point I would like to make. In many branches of the industry requiring high-duty castings, the importance of strict uniformity of properties and behaviour is being increasingly stressed. The importance of this is so great that a lower standard of properties and behaviour will be accepted if it is accompanied by strict uniformity. It is partly to meet this requirement of uniformity that refined irons have made such progress during recent years. The use of alloy additions requires very careful consideration from this point of view as it is by no means easy in practice to maintain a desirable standard of uniformity when making such additions

I believe there are circumstances where the use of alloys in cast iron can be resorted to obtain properties or qualities which would be difficult to obtain otherwise. A very full understanding of the influence of alloy additions is necessary to enable their use to be intelligently pursued. From this standpoint your work is and will be of very great value.

Inadequacy of Test Bar Results.

DR. EVEREST, replying to Mr. Hurst's expression of disappointment with the meagre nature of the so-called improvements effected in recent work on alloy additions, pointed out that Mr. Hurst was referring to test-bar results, and with test-bars one was working under strictly limited conditions. One generally could not increase the strength much beyond a limit, of about 20 tons per sq. in., and in his opinion one could not expect very great improvements when working on a material the quality of which was very high in the first place. When one considered an actual casting in which the strength of an inside part, as, for instance, the bore of a cylinder, was of the utmost importance, one would appreciate that test-bar results meant nothing, but he claimed that by securing uniformity of hardness and structure in the various sections of the casting one obtained very much improved strengths in the vital parts, which improved strengths would not be obtainable at all if an ordinary mixture were used. Mr. Hurst had asked whether the improvements accompanying the alloy addition were greater than could be obtained without the addition. The answer was emphatically yes. With an ordinary cast iron containing the ordinary elements—silicon, manganese, sulphur, phosphorus, and so on—one could not obtain the uniformity of structure he had indicated, which uniformity was being secured in castings on a production basis. The piston problem was typical of the sort of problem one was up against. In a piston made of silicon-iron unsoundness would occur either in the heavy boss or else chill would be seen in the skirt under certain casting conditions. Using nickel-iron, one could produce the casting perfectly sound in the boss, and yet machinable all over. It was being shown conclusively that with alloy irons one could obtain properties which were not obtainable with ordinary irons. Mr. Hurst had made further reference to the uniformity of the products; all that was stated in the Paper indicated the tendency towards uniformity. He (Dr. Everest) had mentioned that in silicon-cast-iron there was attained a stable condition at the pearlitic matrix; when nickel-iron was used, that stable condition existed over a wider range of conditions. A hardness of 220 or so was attained in sections varying from $\frac{1}{4}$ to 1 in., but one could not produce that state of affairs in silicon-iron; there was certainly a greater uniformity of product when alloy iron was used. Moreover, with a low-silicon nickel-iron one obtained a more uniform product while the composition was undergoing the usual variations occurring in practice—variations which under ordinary conditions would probably produce waster castings. Mr. Hurst had noted that there were circumstances in which alloy iron could be useful He (Dr. Everest) was convinced that there would be more such circumstances arising in the future.

MR. J. R. NUNNS paid a tribute to Dr. Everest for the very practical manner in which he had dealt with the subject, and added that the work described in it was obviously the forerunner of further valuable work on cast iron. He asked whether, as the result of the addition of other metals and alloys to cast iron, it was necessary to provide extra feeding facilities or denseners. In this connection he pointed out that no two men would feed castings of the same character in like manner, and the human element entered very largely into foundry problems.

L'effet Leonard.

MR. A. S. BEECH agreed that to a large extent the Paper was practical, but at the same time, and with all due deference, he pointed out that Dr. Everest had dealt with some of the matters raised more from the scientific point of view than from the point of view of absolute practice in the foundry. Commenting upon Dr. Everest's reference to the importance of ensuring that the bosses of pistons were solid, Mr. Beech recalled that some years ago Mr. Leonard, in Belgium, had carried out some experiments in which he had demonstrated that it was perfectly possible, by the proper making of the cores and the moulds, to eliminate porosity in piston-bosses. No nickel had been added to the metal used in those experiments. The composition was normal grey cast iron and it was shown that the porosity was not due to the silicon in cast iron, but was due to the trapping of gases. Mr. Leonard had said that the reason usually given in the foundry for porosity was that the casting was a drawn casting where the thick and thin sections of the metal came together, but he had expressed the opinion that it was impossible in view of the very low cooling-rate, as between the thick and thin sections, to obtain a drawn-casting at that point. In the particular case of automobile pistons referred to by Dr. Everest, he had produced perfectly sound castings by using a fillet, cutting out the sharp edges and making the core more porous.

More Research Needed.

MR. JOHN SHAW, after expressing indebtedness to Dr. Hanson and Dr. Everest for their splendid work in respect of alloy additions to cast iron, gave his opinions with regard to some of the points raised (which opinions, he said, might be quite wrong, but would at least introduce a fresh viewpoint) without entering into Dr. Everest's general theory which was controversial and might obscure the main issue. Mr. Shaw produced a complete set of analyses, as published in various Papers by Dr. Hanson, Mr. Turner and Dr. Everest, and said one could not help noticing the variation in results which was apparent when one set of figures was compared with another. It was true that each complete set of analyses fell into line with the conclusions stated in the Paper. At the same time, if one studied the effect of P and Ni, as shown in the Paper, one found that a T.C. of 3.5 per cent., plus Si 1.19 per cent., gave a C.C. of 1.65 per cent., with an iron from a washed-iron base. From the refined iron with T.C. 2.9 per cent., plus Si 1.71 per cent., the C.C. was only 0.74 per cent., while a straight cylinder-iron with T.C. 3.28 per cent., plus Si 1.03 per cent., had a C.C. content of 0.89 per cent. The same thing occurred in regard to tensile tests; the figure for a straight iron was only 12.3 tons, whereas the figure for a refined iron was 19.8 tons. It was only fair to state however, that the T.C. was 0.12 per cent. lower in the latter iron. He asked Dr. Everest if he could not settle this matter by making a set of 2.2 in. bars (0.8 in. was too small) from a washed-iron base, and a straight pig-iron of a similar analysis. From recent experiement he had no doubt that neither structure nor physical properties were the same in both cases; nor could one accept unconditionally the statement that "the graphite form cannot be separated from the condition of the matrix in ordinary iron." The micros shown by Mr. J. E. Hurst and Mr. Pearce were exceptions as were also some of the results given in Dr. Everest's Papers. Mr. Shaw pointed out however that his remarks were not intended as a criticism of the valuable investigations made by Dr. Hanson and Dr. Everest in regard to the addition of nickel to pure irons; he wanted to emphasise that in obtaining analyses for practical works conditions, irons such as were used every day in first-class work should be the basis of the experiments. The fact that Dr. Everest had found that two of nickel was about equal to one of silicon instead of four of nickel to one of silicon was a case in point. The latter figure was no doubt right for the synthetic material he had been using. In the motor-cylinder experiments a refined-iron was used; the result of this might be to add another £2 to the cost.

An Ameliorative Addition.

With the general trend of Dr. Everest's findings concerning nickel-additions Mr. Shaw was in accord, and there was no doubt, he added, that but for the careful and thoughtful work of Dr. Everest our knowledge of the subject would not have advanced as it had done. As an example of the effect of nickel on the equalisation of structure, he mentioned the production of some sleeves which were required to stand up to 3,000 lbs. pressure per sq. in. These sleeves were being made from an expensive refined-iron, the analysis of which he had considered to be perfect. Trouble had occurred from time to time, however, but it was not due to dirt or scum; subsequently the foundry manager concerned had tried the effect of adding 1 per cent. of nickel to the low-silicon mixture,

* Discussion on a Paper entitled, "Alloy Cast Irons," read before the London Section of the Institute of British Foundrymen, by Dr. A. B. Everest, and published in our issue of January 17.

and since then there had been no further trouble so far as he (Mr. Shaw) was aware.

Reducing Losses.

Commenting on Dr. Everest's reference to the importance of reducing the silicon-content when adding nickel, he pointed out that the effect of high carbon-content was equally pernicious. It had been stated that a difference of 0.32 per cent. in the total carbon-content gave a great deal more chilling-effect than one would think. He had not obtained good results when the carbon-content was 3.5 per cent. or over, on a 1.2-in. bar. Discussing the method of adding nickel and chromium, he said that much depended upon the quantity of metal one required in the ladle. Where the quantity was small, say 10 cwts., it was best to take it down the spout, but in the case of larger amounts it was best to charge in lump-form in the cupola. It was his practice to place the whole quantity in the middle charge, and under those conditions there was very little loss. It was the practice to blow the metal required for the job, and then re-charge. Hot-melting was essential, whichever method was employed. It must be remembered that the freezing-range was shortened, and there was less time to get to the moulds.

Effect of Nickel on Thick Sections.

Dealing with the effect of nickel upon thick sections, such as those in marine-cylinders, Diesel-liners, etc., he asked if Dr. Everest had any evidence that nickel alone produced the equalisation of structure that was needed. That the addition of nickel and chromium had this effect on some work was common knowledge but here again the total carbon content was important. He also asked for information as to the effect of these additions upon the correct reading of the optical-pyrometer. There were very definite opinions held that due to the different surface-colour of the molten metal the readings of the optical-pyrometer were always 150 deg. C. below the correct temperature.

In a further expression of appreciation of Dr. Everest's really practical work, and a tribute to his keenness, Mr. Shaw recalled that Dr. Everest had given up a day of his holidays and had made a cross-country journey in order to see a casting made; when a man was prepared to do that it could be taken for granted that he was keen on his job.

MR. WESLEY LAMBERT (President-Elect of the Institute) asked for further information as to the form in which nickel and chromium were introduced, and as to the practical manipulation of the alloy-irons in the cupola and on the foundry floor. Did Dr. Everest recommend that the nickel be added as nickel or as ferro-nickel?

Author's Reply.

DR. EVEREST, in replying to the discussion, thanked Mr. Minns for his appreciative remarks. With reference to the question of feeding facilities or denseners, he expressed himself as of the opinion that no special precautions were required in using the alloy-iron; in fact, it had been his experience that, resulting from the action of nickel, there was less need for denseners and special feeding facilities when this class of iron was cast.

Replying to Mr. Beech, the author said he did not for a moment claim that troubles due to porosity in the bosses of pistons could not be overcome in other ways than by adding nickel; he had mentioned the elimination of the trouble by the addition of nickel as a typical example of the sort of thing one could do with this element, and there might be many cases in which the trouble could be eliminated more simply by the use of the alloy element than by carrying out an extensive investigation into design, and so on. Very often the foundryman had no control over design, and in such cases he might find the alloy of very much assistance to him.

Commenting on Mr. Shaw's reference to the total carbon content and its influence on the structure of cast iron, he said that in the first place he had thought that it would be desirable to use irons with low total carbon content in order to get the best results in the presence of alloy elements. He had carried out practical work, however, in two foundries turning out automobile castings, one turning out castings containing 3.1 per cent. total carbon and the other turning out castings containing 3.5 per cent. total carbon. The foundry making castings with a 3.5 per cent. total carbon content was making real progress with alloy-irons, was using very considerable quantities of nickel every month, and was definitely getting good results. Therefore, he had purposely omitted any reference to total carbon content, because he was not quite sure that we knew where we stood with regard to it, and good results were being obtained with irons giving all sorts of total carbon contents. Mr. Shaw had mentioned the expense of using refined iron in motor cylinder experiments. Dr. Everest wished to make it quite clear that in experimental work all types of material might be employed to obtain a desired result, but he sincerely hoped that the details of any experiment would not be taken as the last word, and thus obscure the final issue.

Mr. Shaw made some reference to the shortening of the freezing-range. Experience to date surely did not substantiate this, and he (Dr. Everest) was unaware of any reliable evidence for this statement. With regard to the temperature of the metal as measured by the optical-pyrometer he had no evidence. Inasmuch as silicon and chromium were oxidisable, probably they would produce a skin on the metal, which skin would affect the pyrometer, but he would not anticipate that nickel would produce any such skin, because it was not oxidisable.

Practical Points for Alloy Additions.

Dealing with Mr. Lambert's reference to the methods of adding nickel, the matter had not been referred to in the Paper, because in an article he had contributed to THE FOUNDRY TRADE JOURNAL* recently he had given the complete story as to the different forms in which nickel and chromium could be added to cast iron and the different ways in which it was added—whether in the cupola or in the spout. Nickel in the form of pure nickel-shot was not a suitable form in which to add it to cast iron; at any rate, in the spout or in the ladle, because its melting point was too high and the pieces were too large; when efforts were made to add it in that form undissolved nickel was found in the finished castings. In a certain foundry recently he had been told that nickel could not be added, and the reason was that they had tried to add it down the spout of the cupola as ordinary nickel-shot. He had attained a certain amount of success with a pure nickel-shot in a very fine form, but he was not sure that it was generally obtainable in that form. For those who wished to add nickel in the spout or in the ladle—as was usual when making up only small quantities of iron—there was on the market a special shot containing 92 per cent. nickel and 6 per cent. silicon; the melting point of the shot was about 1,250 deg. C., whereas the melting point of pure nickel was about 1,450 deg. C., so that the melting point of the nickel-silicon shot was comparable with that of cast iron. He had not experienced difficulty in getting that into any class of iron; quantities up to 3 per cent. could be added to even the high-phosphorus iron used in engineering foundries for making large castings, the feeding temperature in those cases being about 1,250 deg. C. In most of the cases referred to in the Paper, however, the quantity of nickel was 1 per cent., and that quantity would give all the results one would expect to get economically with ordinary irons. If the quantities of metal to be dealt with were small—less than 2 cwts.—there might be trouble in adding it to the ladle, because one would not have time to stir, and so on, but with larger quantities there was no trouble. If, as he had recommended, the nickel were added as the iron entered the ladle, so that all the nickel was added by the time the ladle was half full, one would get all the nickel into solution. He usually added chrome as ferro-chrome, but it was essential that it should be obtained in a crushed and graded form. Days might be occupied in crushing a carbon-free ferro-chrome; in one case three days had been occupied in crushing a few pounds. Ferro-chrome could not be added to a ladle of iron if it were in pieces as large as a pea. The recommendation was that the chromium should be added as a crushed and graded carbon ferro-chrome—usually containing about 6 per cent. carbon—sifted so that it would pass a 10-mesh sieve and would be retained on a 50-mesh sieve. The reason for the reservation was that when the ferro-chrome was crushed there was a liability of a good deal of dust being formed, and this was waste, because it tended to burn on the surface of the iron or in the atmosphere above. He knew founders, turning out alloy-irons regularly, who were passing nickel and chromium through the cupola; where there was a big tonnage, and there was no danger of getting the metals mixed up, that was probably the best method.

* F.T.J., Jan. 3, 1929, p. 5.

Vote of Thanks.

MR. V. C. FAULKNER (Past-President of the Institute and of the London Branch), proposing a vote of thanks to Dr. Everest for his Paper, said it had been suggested that Mr. Henry Ford had made the mistake of his life recently in placing his new model on the market and continuing to call it a Ford; Dr. Everest and his associates were probably making a similar mistake by placing a new product on the market and continuing to call it cast iron, and they would have to orient their conception of cast iron and have regard to this point of view. In expressing indebtedness to Dr. Everest for his Paper, he said it had clarified a whole mass of literature which had been at the disposal of the industry during the past few years. He could not have given a better summary of the position, and his hearers would leave with the knowledge that by the use of nickel the thin and thick sections of cast iron could be made more like one another, and that, although the thin sections were a little hard, they were still machinable.

The vote of thanks was seconded by MR. V. DELPORT, and was accorded with acclamation.

New Companies.

Tungum Metal Company, Limited, 150, Southampton Row, London. W.C.—Capital £400. Directors: C. T. Pollard and G. Dearle.

Clarendon Pressing & Welding Company, Limited, Clarendon Works, Clarendon Street, Coventry.—Capital £3,000 in £1 shares.

Ormond Brassfoundry, Limited.—Capital £800. Directors: W. Horton, 50, Claremont Road, Handworth, Birmingham; and C. Knutton.

Scott-Snell Laboratories, Limited, Chandos House, Palmer Street, London, S.W.—Capital £1,000. Engineers, etc. Directors: C. Scott-Snell, E. Scott-Snell and R. E. Heard.

George Ellison, Limited, Wellhead Lane, Perry Barr, Birmingham.—Capital £125,000 in £1 shares (30,000 preference). Engineers and makers of electrical control switchgear, etc. Governing director: G. Ellison.

Haynes & Ford (Stampers), Limited, 47-49, Northampton Street, Birmingham.—Capital £4,000 in £1 shares, to acquire the business of E. F. Haynes, Limited, and to carry on the business of die-sinkers, stampers, etc.

Associated Edge Tool Industries, Limited, Chillington Tool Works, Wolverhampton.—Capital £236,500 in £1 shares (148,970 10 per cent. cumulative preference and 87,530 ordinary), to acquire not less than 90 per cent. of the issued share capital of the Chillington Tool Company, Limited, and of Edward Elwell, Limited, and to carry on the business of tool manufacturers, etc. Directors: J. K. Hunt, H. W. Hunt, B. E. Hunt, W. J. Holloway, H. T. Elwell, C. E. Elwell, G. Elwell and H. W. Waldron.

THE TENDER of Messrs. Babcock & Wilcox, Limited, Renfrew, to supply three boilers for the new power-house of the City of Brisbane, at a cost of £74,266 has been recommended for acceptance as being on a comparable basis the lowest tender.

THE SOUTHERN RAILWAY COMPANY have passed an order for two new cross-Channel steamers for the Southampton Channel Island services. The vessels which will be built at Dumbarton, by Messrs. Denny Brothers, will, it is stated, surpass in comfort any steamer hitherto put on the Channel Island service.

Institute of British Foundrymen.

ANNUAL MEETING OF THE EAST MIDLANDS BRANCH.

Members from all parts of the area were present at the annual meeting of the East Midlands Branch of the Institute of British Foundrymen, held at the Loughborough Technical College on January 26. Mr. H. Pemberton, of Derby (Branch-President), occupied the chair.

MR. H. PEMBERTON (Derby), who mentioned that his term of office as President of the Branch would expire that night, said there was no doubt that the Branch was advancing as an important organisation, and he expressed the hope that they would continue to give their support in the future as they had done in the past.

MR. H. BUNTING (Hon. Sec.) presented the balance-sheet, which showed that, at the beginning of 1928, they had a balance in hand of £5 8s. 3d. Members' subscriptions had amounted to £147 10s. 6d. After all expenses had been met, there was a balance at the end of the year of £17 9s. 9d.

The financial statement was unanimously passed.

A Year of Progress.

Commenting on the work of the past year, Mr. H. Bunting said he thought there was every reason for satisfaction. Several good meetings had been held, and visits paid to various works, which had proved highly interesting and instructive. Since last September they had been most active. The session opened with a visit to the works of Messrs. Worthington Simpson, Limited, Lowfield Foundry, at Newark, which was followed by a joint meeting with the West Riding Branch. It was a very successful occasion, and a report was published in THE FOUNDRY TRADE JOURNAL. Since then a meeting had been held at Leicester, and another at Derby, and on both occasions they had been favoured by good attendances, and the addresses given had provided much useful information, which had been freely discussed. During the present year other events were to take place, and he would appeal that they would continue to attend in large numbers. So far as the membership was concerned, they had on December 31 last 38 members, 68 associated members, 4 associates and 4 subscribing firms, making a total of 114. During the year they had admitted 7 full members, 12 associated members, 1 associate and 3 subscribing firms, making a total of 23. Through resignations and death they had lost 11 members. With regard to the Branch library, he did not think it had been in quite such great demand as in past years, but no doubt the members had had their time occupied with the convention that was held at Leicester. He would, however, point out that if any of their members were desirous of loaning certain books that were not already in the library, that the Council would only be too pleased to provide these. Of course, if the books were not used sufficiently, they would not be able to justify the expenditure, and he hoped that would be borne in mind. Still, if the members wanted to avail themselves of new books, they would be procured. They had already made a good start, and he hoped it would continue. The event of the session was the annual dinner, to be held on March 2, and he expressed the hope that there would be no absentees. They now had the pleasure of welcoming Mr. Russell at their dinner as President of the Institute.

Tribute to Mr. Bunting

MR. H. PEMBERTON (Derby), in proposing the adoption of the honorary secretary's report, paid high tribute to the efforts of Mr. Bunting, whom, he said, was a model secretary and second to none in the Institute. They all knew the good work he did for the welfare of the branch and its members. He had to devote much time in their interests, and, speaking as a man who had held the office for a year, he could thoroughly appreciate all that Mr. Bunting had to do, and he did it well. But since he (the speaker) was secretary the branch membership had increased by about 400 per cent. and they must remember that the secretary's work had increased by that percentage also.

MR. S. H. RUSSELL (Leicester), in seconding, assured them that the East Midlands branch was greatly esteemed by all other branches in the Institute, and so was their secretary. It had been said that the East Midlands' branch was rather a scattered area, but he would ask them not to bank too much on that, for as President of the Institute he had travelled greatly, and, therefore, knew the conditions of other branches, and he instanced that of South Wales, which had members in Cardiff, Swansea and Bristol. Perhaps, to them in the East Midlands, the towns might not sound very far apart, but he could assure them that each place was about 50 miles from the other, and it was sometimes difficult in arranging meetings. Then there was the West Riding branch of Yorkshire, which had headquarters at Bradford, and they worked under somewhat similar adverse conditions to those which prevailed in the East Midlands. Neither of those two branches did as well as the East Midlands in regard to attendances, and he thought they ought to feel proud they had a man like Mr. Bunting as their secretary. "He has held office as secretary longer than the secretary of any other branch in the Institution, and, therefore, he is really the senior branch secretary." (Applause). Great credit was due to Mr. Bunting on the splendid way he handled matters. Their branch had grown, and he would appeal to them to keep on forging ahead. With regard to their branch library, he would suggest that they might have copies of THE FOUNDRY TRADE JOURNAL bound and kept for reference. They had a good fund, and if they could have a bound file of their trade organ it would be most valuable. "It is a good paper, and one which I hope every foundryman takes in," proceeded Mr. Russell, who further suggested that arrangements might be made to obtain back numbers of the Journal. He had great pleasure in seconding the report and adding his tribute to Mr. Bunting, who was a valuable asset to the East Midlands branch.

The report was unanimously adopted.

Election of President.

Mr. Pemberton said the East Midlands were desirous of obtaining the best men possible, and it was up to the meeting to see that a real Council was elected. With regard to the members who had served on the Executive during 1928, he could say that they had done their work well, and had the interests of the branch and the Institute at heart. He would like to propose Mr. J. Lucas, of Loughborough, who was the senior vice-President of the branch, as his successor. Mr. Lucas was one of their most enthusiastic members. They all knew his abilities, and he had done much to increase importance of the section. He referred to the splendid efforts of Mr. Lucas in taking part in the arrangements for the convention that was held with such great success in Leicester last year. That work would never be forgotten, and he thought by electing Mr. Lucas to the highest position the branch could offer, they would be showing their true appreciation of a valuable member.

MR. A. S. CLARKE, in seconding, said they could not do better than elect Mr. Lucas as their President. He was convinced that he would successfully pilot the branch through the year.

Mr. Lucas was elected President with a unanimous vote, Mr. Pemberton offering his congratulations to their new leader, whom he expressed the hope would have quite as pleasant a term of office as he had had. The responsibilities of the President were increasing each year, but he could assure his successor that he would have the full support of the members.

MR. LUCAS thanked them for the honour they had conferred upon him and the kind words that had been said. He recalled the days of 1916 and 1917, when they had difficulty in getting the members to attend. Still, they managed to carry on. He realised that having been appointed President, he would have no easy task to emulate the splendid example that had been set by his predecessor, and other distinguished men in the industry who had held that office, but he would promise to do his best and hoped that he would have the full confidence and the support of all the members. In conclusion, he said: "It will be my best endeavour to serve the branch, while not forgetting the claims of the Institution as a whole."

Mr. Pemberton proposed that Mr. Goodwin be elected as their senior vice-president, and at the same time wished to extend to him, on behalf of the branch, their very deepest sympathy in the loss he had sustained by the death of his father, and hoped their message would go out to him through THE FOUNDRY TRADE JOURNAL.

The election was unanimously carried.

MR. A. S. CLARKE said he would like to propose that Mr. Tom Spiers, of Leicester, be elected as the junior vice-president of the Branch. He was a very active member, who was most sincere in all he did for the benefit of the Branch and its members. He would fill the office with distinction, not only to himself, but to the members of the Branch at large.

MR. P. A. RUSSELL, who seconded, said that Mr. Spiers had been associated with the Branch for a long time and had accomplished a good deal of valuable work for the General Council.

MR. PEMBERTON said perhaps the most important office of the Branch was that of hon. secretary, and he would propose that Mr. H. Bunting again be asked to fill that post. He was a highly capable official.

MR. LUCAS seconded, and MR. A. S. CLARKE supported.

The election was carried with acclamation.

MR. H. BUNTING, in reply, expressed thanks for the confidence the members continued to place in him, but he would make one appeal to them, and that was when they were written to by the secretary and asked to reply they would do so. He would again try to do his best in the interests of the members and the Branch, and hoped that when the end of his term of office arrived they would all feel satisfied with the confidence they had placed in him.

MR. E. STEVENSON (Nottingham) proposed that Mr. H. J. S. Hilton and Mr. W. F. Smith be re-elected as honorary auditors, and wished to congratulate them on their work during the past year.

MR. W. HAMMOND seconded.

MR. PEMBERTON said they required two representatives to represent the East Midlands on the General Council. As they were aware Mr. Vaughan was the retiring delegate, but was eligible for re-election.

MR. LUCAS proposed, and MR. EVANS seconded, the re-election of Mr. Vaughan.

MR. E. STEVENSON, in proposing Mr. C. Blades (Syston) as the second delegate, said he felt sure he would make an efficient officer for that position.

MR. P. A. RUSSELL seconded, and the election of the two delegates was carried uanimously.

Messrs. C. W. Bigg, C. Blades, and E. Peace were re-elected members of the Branch Council.

MR. A. S. CLARKE, in proposing a vote of thanks to the retiring officers for the services they had rendered to the Branch during 1928, said they had all done their work well. Really, they had put that necessary energy into everything that went towards success. While, perhaps, they had not always agreed in detail in the great matters appertaining to the East Midlands Branch, they had never failed to bring their meetings to a satisfactory and happy ending, and that was why their Branch stood in such an unique position so far as the Institute was concerned. Speaking on behalf of the whole of the members he wished to thank the officers for the part they had played. The young foundrymen were quite interested in the work of the Branch, and he hoped to see some of them in office in the future. The Branch had been prosperous, and he thought there were still brighter days to come for their organisation.

MR. F. GILL seconded, and the vote was carried unanimously.

The CHAIRMAN acknowledging the vote of thanks accorded the retiring officers, said that he could

testify to the good work that they had accomplished during the year; in fact, that was why they had been able to hear such a satisfactory financial report.

Short Paper Competition.

The Chairman said they had been able to promote a short paper competition, and there had been six entrants, their respective subjects being:—(1) "Cause and Prevention of Scabbing"; (2) "Preparing and Charging a Cupola"; (3) "Can Oil Sand be Used Too Much?"; (4) "Oil Sand for Core Making and Melting"; (5) "Spare the Rod and Save the Job"; and (6) "Safety First in the Foundry." Of course, the members would have to record their votes after the papers had been read, and he would ask Mr. J. F. Driver to read them.

Cause and Prevention of Scabbing.

By F. Butters.

Although the subject under consideration is a wide one, it is at the same time an old one, and one can hardly hope to suggest anything new, but it is worthy of still further consideration, as it still continues to add an unnecessary quantity to the scrap heap. If scabbing is due to confined gases then one has only to make provision for their free escape, but this is easier said than done. Undoubtedly hard ramming is a frequent cause, yet the jarring machine rams moulds much harder than as usual by hand, but without the same risk of scabbing. This is probably due to even ramming, and the fact that there is no actual rammer pressing in any one particular place and so causing hard spots. Therefore hard ramming near the pattern should be avoided. This can be done by placing a good layer of sand on the pattern and treading with the feet before ramming. *Wet sand* is also a cause of scabbing, due to excessive moisture creating vapour which cannot escape through the proper channels and the metal being unable to lie on the sand, owing to bubbling causing the sand to peel off and leave a scab. This can be avoided by using sand that is only sufficiently moist to be workable. *Insufficient venting* is the most frequent cause of scabbing. It can generally be overcome quite easily by adequate venting and providing for the free escape of all gases, otherwise they may force their way back into the mould with deleterious results. For the same reason all vents that have struck the pattern should be carefully stopped up. *Facing sand*: Various means are used to obtain the necessary porosity in the sand, chief of these being sawdust and dried horse manure. An occasional scab may be formed through an iron rod being too close to the surface, particularly if the area of the iron is large and smooth, such irons should be avoided. Another frequent cause of scabbing is excessive sleeking, and whilst a certain amount of sleeking is necessary it should only be done lightly, as sleeking only tends to close the pores in the sand. It is better to use a cork block for sleeking wherever possible, and on no account must sleeking be done after using the swab as scabbing is certain to result. There may be other minor causes such as slow pouring. In this case the metal is poured so slowly that the pressure of the gases under the surface is greater than the pressure in the mould, and as the gases always leave in the line of least resistance they force their way back into the mould and cause a scab. Proof of this is very often found when a riser "lifts" and the pressure in the mould is eased. To remedy this the mould should be poured faster and any surface liable to scab will be covered quicker. The increased pressure will force the gases through the mould. Proof of this may be had by noting the casting of an open sand plates, where, owing to the absence of pressure the slightest hardness or dampness will cause bubbling and scabbing. While there may not be a sure preventive against scabbing, if the suggestions put forward are carried out the risks of scabbing will be greatly reduced. One real help against scabbing is the use of sprigs. If the part of the mould that is liable to scab is well face-sprigged and all other reasonable precautions have been taken, there is practically no risk of a scab. If one should occur, the sprigs prevent it from spreading, which would most likely happen if sprigging had not been effected. The foregoing remarks are more or less applicable in dry sand moulding or core making. The situation of the ingate should be considered and the most suitable position chosen, as scabs may be formed in a variety of simple ways. Finally *coal dust*, which does not rank among the common causes of scabbing, but it constitutes one which must not be overlooked, as a poor quality may contain a much lower percentage of volatile matter and so increase the risk of scabbing.

Preparing and Charging the Cupola.

By B. Gale.

Preparation.

The cupola lining should be fettled and patched after every "blow." Particular care should be taken to keep the lining true to shape and size, or the bed-coke will be constantly varying in weight when charged to a definite height above the tuyères. A small daily patching will keep the lining in far better condition than occasional heavy patchings.

In a drop-bottom cupola, the bottom, of floor sand, should be about 4 in. thick. The sand should be tucked firmly round the joints of the doors, and the whole rammed moderately. It is a mistake to ram the bottom very hard to prevent a burst. The molten metal is likely to tear up a hard bottom in the same way as a mould scabbing. If the fire is lit early, about 3 hours before blowing time, the results obtained will more than compensate for the small amount of fuel burnt. The fire should be fed with fuel to just above the tuyères.

Charging the Cupola.

Charging can be commenced just before blowing time. The bed-coke should be weighed on for cost purposes, but also measured to a recognised height above the tuyères. The author charges the bed-coke to 18 in. above the tuyères. The first iron-charge then follows, and then coke and limestone for the second iron-charge, and this procedure is continued until all iron is charged. All charges must be weighed. The iron-coke ratio will vary in different foundries, but the coke should be kept as low as possible for economical melting. The late Robert Buchanan termed economical melting as "The least amount of coke to melt a given quantity of iron at a suitable temperature for castings to be made." The coke-iron ratio is determined by experiment. Start with a liberal amount of coke. This will give hot metal, but the melting time will be slow. Reduce the amount of coke a few pounds daily until a reduction in temperature is noticeable. Then go back to the previous day's amount of coke and keep to this for constant practice. Too little coke will give dull iron, and possibly the appearance of a lump of pig-iron at the tuyères. Too much coke is wasteful, the excess coke has nothing better to do than to burn out the cupola-lining. The author charges 10 lbs. of iron to 1 lb. of coke for metal required hot. Charges should be small, especially where small quantities of molten metal are to be tapped, or one ladle will contain all pig, and the next all scrap-iron. The charges should, however, be large enough for the coke charge completely to cover the iron charge, so that the charges of iron and coke form distinct layers. Limestone should be sufficient to give off a fluid slag. The author finds 1 lb. of stone to 50 lbs. of iron suitable.

When two or more grades of iron are required, particular care must be taken in estimating the amounts of each class of iron required. As it is impossible to calculate the exact quantities, the author makes an allowance of one charge of iron at the change-over. It is more economical to make common castings with cylinder-iron than to cast cylinders with common iron.

The final item to be prepared is the bot. The first bot should be made long and tapered completely to fill the hole in the breast. This bot is made with a shell of clay, the centre being filled up with coal-dust. When the first metal is to be tapped the coal-dust comes away quite freely, and only a small thickness of clay is to be tapped away. This type of bot will prevent a "hard hole." The remaining bots are made with ordinary clay. It is advisable to have two or three bot-sticks ready throughout the blow.

Can Oil Sand be Used Too Much?

By Fredk. Gill.

One often finds that a foundry will not entertain the idea of using oil sand, owing to the high cost of its raw materials, as compared with that of natural-bonded sand. After several years' tests as to which core sand is the cheaper, oil sand was the more economical. This does not mean that the initial cost of the materials is below others, but taking everything into consideration the costs of the finished castings were down to a minimum.

As an aid to moulding, oil sand is invaluable. How many times does the foundry receive patterns with awkward slots and facings on the sides and bottom? Moulders spend much time in patching and sprigging these parts of moulds, yet an oil-sand core, rammed up with the pattern, makes the job much safer and does it in a shorter time. When making large castings that have to be run in the bottom, it is far better to overcome the difficulty of making the ingates by using an oil-sand core-runner, instead of drawing in the runner patterns and having to sprig all round. By such simple methods as these a little oil sand saves much time on a mould, and provides one free from washing, scabbing, etc.

A few weeks ago a press-tool casting had to be made. It was out of proportion to the moulding boxes available. The nearest box for the job only allowed 1½ in. of sand at each end, and the job being rather deep and heavy, it would have been dangerous to work with so small a box. The next size box was far too large, and would have taken too long to ram it up. Therefore, it was decided that the small box be used, and an oil-sand cake rammed up at each end of the pattern. This was not difficult owing to the pattern being straight at the ends. On withdrawing the pattern, the oil-sand cakes acted as a guide, and the result was a draw completely eliminating any mending. The two hard oil-sand cakes prevented any metal getting through to the box-joints, and the faces were good and perfectly free from scabs that may have occurred had the job been rammed up in green sand of so small a thickness.

Another instance of oil sand aiding moulding was in the making of large coke-hopper castings. From an ordinary pattern, this job would have been three-part moulding, and loose draw-in flanges in the middle part, and would have been a day's job for a moulder. To speed up production the pattern was made to mould the opposite way, and this made the moulding a plain two-part job, but the middle had to be cored up instead of using a green-sand cod. The core would have been very heavy, so it was made up of four cakes 1½ in. thick. These were placed in the mould and the inside filled up with bricks and sand. It took approximately four hours for one man to make three sets of cores, and the moulding output was increased from one to three castings per day. After finding that oil sand used freely saves so much time, the writer concludes that the initial costs of the materials need not be looked upon as being too high.

Oil Sand for Coremaking and Moulding.

By F. Burgess.

It is difficult to say which is the best sand to use, there being so many grades suitable for some branches of the foundry trade only.

Southport sand is good for brass, gunmetal, or grey iron. It should not be used too freely for general work, aluminium, or malleable iron, owing to the contraction, which the closeness of the grains will resist and cause cracks. Although oil-sand is used considerably on all kinds of metals, they are of different mixings and strengths.

All sand should be dried and allowed to cool before mixing, giving the oil a better chance to

cover every grain of sand, thus ensuring a uniform mixing. If water is needed, it should be added after two or three minutes mixing, until the required bond is obtained

All cores should be rammed solid, or tucked—the harder the better. If venting is varied according to the ramming, all oil-sand cores should have at least one vent suited to its size, to allow the gases to escape as fast as possible. The moulder should see they are taken away freely, for in some cases, they are driven back into the mould, which will cause porous castings. Wax vents should be done away with in every possible case, open vents always being preferable, as the burning out of the wax weakens oil-sand cores.

The baking of oil-sand cores, must be left to the core-shop foreman, or man in charge of the stoves. One cannot give any definite time or heat, as stoves are not the same in every shop, and the different mixings require longer or shorter times, according to the grain sizes, or size of cores.

When building up cores or jointing, flour paste is preferable to core-gum. It is quicker to mix, quicker to dry, seldom breaks when stuck together, and is cleaner.

It is advisable in some cases to have level plates which can be made from oil sand to any shape required. Where cores are of awkward shape or size and cannot be turned out on a flat plate, dryers can be made by making a pattern from one half core-box, together with a suitable frame to cover it. It saves much time and trouble by eliminating packing. It also ensures a better drying and can be made to last for years.

All core-boxes should be metal faced, and loose pieces made of metal. Where large orders, or repetition work is produced, one can very soon make bosses or projections of very complicated shapes by cutting the sand.

All oil cores should have as much care as natural-bonded sand, as the core-shop often gets the credit of rough or scabby-looking castings through careless handling, carrying or stacking.

Oil-sand may be used in moulding, where awkward corners or bad lifts occur. Or where one might get little pockets, blowing or scabbing, thus saving extra venting and sprigging.

Spare the Rod and Save the Job.

By J. F. MEASURE.

One of the most disappointing and costly wasters in the machine-moulding foundry is the drawn casting, yet no other type of waster lends itself to so many different methods of treatment for its cure. It is assumed that reference is being made to a foundry turning out high-class castings weighing up to 1½ cwts. each—a type which must be easily machined and free from porosity, whilst using only inexpensive Derbyshire and Nottinghamshire pig-iron.

Undoubtedly a large proportion of the old school of iron founders who have spent all their lives hand-moulding, and who to some extent have the idea that the feeding rod is the one and only cure for a drawn casting, would be hopelessly at sea on machine-moulded work. It can be postulated that a semi-skilled moulder with a feeding rod will create more wasters in less time than is possible by any other method. Apart from the above, it is in no way an easy matter to feed with a rod the day's output of a machine-moulder.

Many of the minor difficulties can be overcome by correctly placed runners, and should it be necessary for a riser, it is essential that it be correctly placed so that the maximum amount of self-feeding is obtained. The size and shape of the runner and riser are also factors of the greatest importance. One of the best methods to help to eliminate the draw is the use of chills. These can be used in several ways, either by placing them round heavy bosses and on the heavy parts where the section is not uniform; or as a substitute for a round core. This latter form will ensure a sound bore. The chill for the bore should have a taper of ¼ in. to 1 ft. This will be found adequate. If the chill is treated with gas tar or shellac it can be easily removed.

A particular instance in mind is that of a balance-wheel weighing about 1 cwt. This is roughly 20 in. in diameter and has a very heavy boss. Its web is 1 in. thick, one quarter being 6 in. thick for the balance weight. By running this casting straight on to the heavy portion through a dry-sand strainer and using the tapered chill cited above, many hours' work with a feeding rod and many wasters have been saved.

Some founders erroneously insist that there is not such a thing as a drawn casting, but that the real trouble is a blow. It is possible, in the author's opinion, however, that many draw holes may originate from a blow.

It has been said that when a casting is causing trouble transfer the job to another man; this is well worth bearing in mind. One casting dealt with by the writer was taken from a hand-ram machine and put into a power squeeze, which reduced the drawn castings from about 33 per cent. to zero. It often pays one to use a box with the top part rather deeper than is at first thought necessary, as it gives the little extra head pressure which often prevents a drawn casting. If a Keep's test is taken each day, it will be found very helpful, and if a contraction of 0.145 to 0.150 on a 12-in. bar, ½ in. sq., is maintained, a minimum amount of trouble will be experienced. This contraction applies to the majority of castings. Finally, *hot metal* is without a doubt the best preventive against a drawn casting. Great care must be taken to ensure that the temperature of the iron is suitable.

Safety First in the Foundry.

By B. CALLIS.

Accidents occurring in and about the foundry, while not so numerous as formerly, are still of sufficient importance to warrant careful attention by all engaged in the industry. Quite apart from the serious nature which the accident may involve, there is temporary disorganisation, loss of productive time, and the subsequent retarded output, all of which are important factors in these days of keen competition, as the foundry, being the pivot of production, a few days behind in casting deliveries means an automatic delay throughout the job.

The question arises, then, "How is it possible to avoid these accidents?" Briefly, the following suggestions may be interesting:—

Human Element.

Perhaps the most important item is the teaching of the slogan "Safety First" to those employed in and about the foundry. This is not an easy problem, but doubtless the best method employed is by showing pictorial posters around the foundry walls calling attention to the consequences which arise through carelessness and thoughtlessness. In fact, the words "Safety First" should be exhibited in all conspicuous places, so that after a time the slogan gets well embedded on the mind, thereby inducing a thinking habit.

Clothing.

A large number of accidents are caused through burns from hot metal, mostly below the knee, which proves the practical necessity of wearing a gaiter by all who come in contact with the pouring or shaking out of flasks after pouring, when, of course, hot sand may be just as dangerous as molten metal.

Shop Equipment.

Mechanical appliances can easily be looked after providing the foundry manager, in conjunction with the engineer, spends a little time in devising a foolproof scheme in guarding. With regard to cranes, lifting tackle, chains, slings, ladles, etc., there should be a regular and frequent inspection, and any defects immediately made good.

In the fettling shop the use of glasses for the protection of the eyes from chips should be strictly enforced. Grinding machines, besides being well guarded, should be equipped with an exhaust system to take care of the dust. The sand-mixing plant should be capable of dealing with the sand in a hygienic manner, and during its process all sprigs, etc., should be magnetically extracted, as no doubt many cuts and abrasions are caused by these getting back to the moulder in the new sand. Great care should be exercised around the cupola tapping-spout, as any excess of moisture—should molten metal be spilt—would cause explosions, and possibly injuries to life or limb.

Another important item is the upkeep of ambulance boxes and stations. These should always be well-equipped with dressings, etc., necessary for giving first aid, and, no matter whether the accident be serious or otherwise, it should be recorded, and drastic steps taken to prevent a recurrence. There are many more things that could be mentioned, such as breaking of pig, charging of cupola, pickling of castings, etc., but those already given are sufficient to show the importance of "Safety First."

DISCUSSION.

The CHAIRMAN, speaking with regard to the result of the ballot, said that the Paper on "Can Oil Sand be Used too Much?" had gained most votes.

MR. W. HAMMOND said he thought the winning Paper excellent, and would propose they have it printed for circulation among the members.

MR. P. A. RUSSELL agreed, and said he would like to see it published in THE FOUNDRY TRADE JOURNAL, of which they were all readers. He would, however, like to know the brand of oil that was used. In his opinion it must be an oil used in connection with that kind of work, for if it were a paste it would absorb the moisture and not carry out its work efficiently.

MR. LUCAS said the Paper mentioned about ramming up some slabs in the hopper casting. He made possibly four slabs of oil sand, placed them in position similar to a box, and then filled the centre up with bricks and so on. He would like to know how the oil-sand cakes were fastened at the back to stop them from falling into the middle.

MR. DRIVER said he could not see how four oil slabs were held. It was, no doubt, interesting how they could be held together with quite a large space in between them.

MR. W. T. EVANS agreed that by using oil sand the cores did not absorb the moisture and become damp. It certainly saved a great deal of trouble. Oil sand had become invaluable in all cases, and especially where there were awkward joints.

MR. BUNTING said he wished to congratulate the authors of the Papers. He would like to amplify one point of his own experience during the week with regard to oil sand and ordinary sand. It was decided to make the mould as well as the core for an extremely complicated casting in oil sand, and the job was all enclosed and cast without box, and it proved a big saving on the production costs besides giving an improved output. When the job was finished he thought the appearance of the casting was decidedly better. Personally, he thought if the foundries tackled the question more they would get a much better article, and, moreover, it would be more beneficial to the foundries than the method under which they had to work.

MR. E. STEVENSON (Nottingham) said there was certainly no limit to the use of oil sand. He could mention numerous cases in which sand cores were beneficial to the moulders. For many types of castings, the moulders incorporated hay and straw, and had a coke bed to keep it from scabbing, but, personally, he would prefer to ram up a piece of oil sand, and so eliminate the trouble. With regard to the use of oil sand, he thought they were only on the fringe of its capabilities. Perhaps in a few years' time they may get the foundations of a permanent mould.

MR. GILL (the author of the winning Paper), who drew a sketch on the blackboard of the oil slabs and the position they were placed in during the casting, said that with regard to the oil used, it was of a very thin mixture, being about 75 per cent. linseed oil, and which he hoped would satisfy Mr. P. A. Russell. With regard to the point raised by Mr. Lucas, he produced a model, and demonstrated how impossible it was for the oil slabs to collapse.

The CHAIRMAN mentioned that Mr. Gill would receive as his award a copy of THE FOUNDRY TRADE JOURNAL for one year.

Blast-Furnace Practice in Germany.*

AN AMERICAN REVIEW.

By F. H. Willcox.

Raw materials used in the Ruhr district of Germany are received from Newfoundland, Sweden, Spain, Africa, and from the minette mines of France and Luxemburg. Perhaps 20 per cent. of the raw materials come from Germany. Fifteen years ago the furnaces were based on a larger proportion of minette and the steelworks used basic iron, i.e., 0.3 to 0.4 per cent. silicon and 1.5 to 3.0 per cent. phosphorus.

While the steel capacity of recent installations consists largely of open-hearth furnaces, usually of the tilting type, there remains a heavy preponderance of basic-Bessemer converter capacity, and the major part of the iron production is of this quality. This requires high-phosphorus ores. The basic iron for open-hearth work is very high in manganese, up to 4 per cent., always over 2.5 per cent. This is because they concentrate practically all their scrap into the open-hearth, where the pig-iron charge is about 25 per cent., the remainder being good plant scrap from mills and pits, the major part being rather poor light outside scrap.

So the high-scrap heat, with its low iron content, melts down with about a 1 per cent. manganese, about the same starting point as with the 50 per cent. hot-metal of 2 per cent. Mn content open-hearth practice in the United States, and is tapped with the same residual Mn. This digression is to explain why they use high-manganese basic iron. Manganiferous ore is nil in Germany. The Germans import all the manganese and conserve it, re-using open-hearth slag and using old ferro-manganese and even spiegeleisen slag. This is concentrated, and so-called slag concentrate—running 12 per cent. Mn—is recharged. Manganese ore comes from Sweden, Africa and the Near East.

With such wide sources of supply the burdens found at various plants are of the most composite character. One extreme case was a three-furnace plant, each stack with 17,000 cub. ft. capacity, producing 1,500 to 1,800 tons of iron a day and using 32 different iron-bearing materials. Another plant near by inland used a burden made up of 40 per cent. Wabana, 20 per cent. high-grade lump minette, and 40 per cent. roasted and sintered German spathic and limonite ores, together with the usual plant by-products. Going over toward Dortmund, one large plant was using 85 per cent. Swedish magnetites, about 40 per cent. sintered, with the remainder made up of manganese ore and plant by-products, while at an adjacent plant Wabana ore made up the major part of the burden. At Bochum, with four furnaces, the burden was made up of sinter, produced from a mixture of flue dust, Spanish, African and Swedish concentrates, all fines, mixed with from 8 per cent. to 12 per cent. coke breeze and sintered on Dwight-Lloyd machines. The Swedish would correspond roughly to the American Harmony concentrates in fineness, but the hematites were seemingly as fine as flour.

Not Much Low-Grade Native Ore.

Germany has considerable ore reserves in Bavaria and South Germany. They are low-grade and apparently have to be roasted before they can be concentrated. It has been found cheaper to import ores than to make use of the low-grade deposits. The turn toward imported ores has given the Ruhr District a distinctly better grade ore to work with than was the case formerly. It gives a distinctly superior burden, as compared with the American somewhat easily reducible ore burdens. The magnetites, sinters and probably Wabanas are not so quickly affected by the reducing influence of the furnace gas.

Their smoothly working furnaces have a practice which follows that of the Eastern district in the United States, where mixtures have been used for many years ranging from 20 per cent. sintered ores and 80 per cent. hematite, up to 85 per cent. sintered ores and 15 per cent. hematite, not to mention the 100 per cent. sintered ore practice. Such burdens invariably give lower blast pressures, lower coke and greater regularity, the furnace taking heat—even on unfavourable lines—without serious tendency to stick and hang. They use some ores in a lumpy condition which blast-furnace operators in America would refuse to charge. In two plants the author's firm is designing for Germany clearance has to be provided in the throat for 14-in. lumps. It is surprising that the German furnaces work as well as they do. It is again surprising, at first glance, that, working with a burden naturally coarse, they show so much interest in rendering fine ores coarser. This can probably be traced to two factors: First, the fear of fine ores is well founded because many plants, where the tonnage has been brought up, are blown by gas engines that cannot keep up the volume with much over 15 lbs. blast pressure. Moreover, the production of basic iron, with its lower silicon, is more sensitive, and, regardless of furnace lines, combustibility of coke and slag characteristics, high blast pressure has to be avoided. Second, the Germans have materials that naturally have to be agglomerated or nodulised or sintered—the latter process being later in practice than in America. Some of the Spanish and Algerian ores are finer than any American plants have to contend with, and are as dry as a bone, and then large quantities of undesirable grades, like pyritic residue and spathic ore, have to be treated.

Sintering African Ores.

The author was informed that it is not so easy to sinter fine African hematite ores as a mixture of hematite and magnetite. The tonnage in the Dwight-Lloyd machines drops off by 20 per cent. In this respect, he believes they check American experience with flue dust and a well-prepared magnetite concentrate, such as is found at Chateaugay. However, their Dwight-Lloyds are not so well laid out as are certain American sintering plants with respect to return of screenings for admixture with the fine ores. They often have good preparation plants for the mixture of ores, the different components being weighed in correct proportions, put through a concrete-type mixer before being charged on the machine. As compared with the rate of production in the United States, they run slower on a tons per sq. ft. per day basis. The quality of sinter is poor, compared with some of the American sinter, but it is so much superior to an admixture of fine hematites and magnetites that it is not difficult to see justification for the practice. Their cost is stated to be 35c. (17½d.) a ton.

Swedish shippers are said to screen out the lumps, sending them to Germany and the rubble to America. So, while smelters in America have come to like, or at least tolerate, fine ores, and have developed furnace lines, fuel, blowers and charging equipment to fine natural ores, the Ruhr district has clung to coarse ores, natural or artificial. And this is all logical: After Americans had set a pace in tonnage output and coke economy, the only way the Ruhr District could follow, with the low-pressure blowing equipment and inflexible tub charging system, was to keep the burden open.

Furnace Construction.

German furnace construction is an inversion of American; that is, a brick stack with steel bands with cooling plates set in, and a steel-plate bosh and tuyere jacket without plates, water-cooled on the exterior. The whole structure is supported on heavy structural framework extending to the top platform. Bells are usually smaller. Linings are 35½ in. thick in the inwall. They use the American conventional type of stockline protection on the top where they do not resort to metal tops. Inwall cooling is carried up to the stockline wearing plates. As a rule they use a cast-iron box on 3-ft. vertical centres, the plate having a 7-in. depth on the face and 9-in. horizontal spacing between plates. The end is open and the water is under no pressure. The plate is in about 20 in. from the face of lining. Bosh angles do not usually go over 78 to 80 deg., though a slope as high as 84 deg. is employed. For their material and rate of driving it is considered in Germany better not to go beyond a 78-deg. bosh angle or over 1,300 deg. Fah. blast temperature.

Furnace sizes vary. The largest stack encountered by the author was built with a 20½-ft. hearth, a 24-ft. bosh and total capacity of 33,000 cub. ft. on a height of 95 ft. This stack used Swedish magnetites, part nodulised, and was credited with 985 tons average production on about 2,050 lbs. of coke.

Regarding high-tonnage furnaces, some remarkable rates are maintained. For instance, one plant makes 930 tons per day on a 22,300 cub. ft. furnace, measured from the iron notch to within 2 ft. of the closed bell. This is done without outside scrap on a yield of 54 per cent. The same size stack in 1914 made 550 tons. The blast volume is 70,000 cub. ft. per min., blown at 14 lbs. pressure through eight tuyeres. A blast temperature of 1,300 deg. Fah. is maintained. The coke rate of 2,080 lbs. seemed high, as did the top temperature of practically 650 to 700 deg. Fah. But the rate of driving is such that the retention period of gas and stock is abnormally short, and, besides, the coarse burden of Swedish minette ores would seem to give a restricted gas-to-ore contact factor. Low-silicon basic iron is produced, and the slag runs 34 to 35 per cent. silicon, 10 to 11 per cent. aluminium, 5 to 6 per cent. magnesium and 45 to 46 per cent. carbon monoxide, with sulphur of 1.5 to 2.0 per cent. Furnaces are cast six, seven and even eight times a day, dependent upon the mixer demands. Parts of casts are put into the sand beds, there being no pig-casting machines at these plants. In a couple of plants the iron is run out in sheets and broken with a ball for open-hearth charging.

Two-stove operation is common, but with three stoves to a furnace, one standing hot and used perhaps every third or fourth round, or not at all, gas being burned occasionally to keep it hot. Many plants operate three stoves and resort to two when circumstances warrant. For practical purposes engine-quality gas must be used. Their efficiency is good, actually 80 per cent with three stoves in operation, and their heat capacity is as much in line. Pressure combustion has to be used, and is, of course, found of several varieties. There is nothing remarkable about the stove fittings except for an excellently developed automatic remote control whereby one stove tender operates two sets of stoves, the valves opening and closing in sequence. A typical German stove is 23 ft. × 108 ft., the chequers being 5½ in. to 1½ in. × 3 in. to 0.82 in., the heating surface 162,000 sq. ft., and the chequer weight, 1,100,000 lbs. A decided distaste for wet washing is noticed at German plants, partly due to recent stringent regulations in regard to dumping dirty water into the rivers. Part is due to the expense of wet washing, both in power and in heat value. Part to the general bother and trouble.

If raw materials are placed on a parity and labour and supplies on a parity, the cost of a ton of pig-iron is approximately $2.10 higher for a Ruhr type of plant than at a modern American plant, using the same materials and labour and material costs. The typical Ruhr plant with its bins, heavy hoist and furnace, elaborate gas-cleaning and gas engines, will cost approximately $26 per ton per year, as against $20 per ton per year in the United States. As to labour, a single-furnace plant will run 5 tons per man per day, as against 6 tons per man per day in the States.

* Abstract of an address before the Eastern States Blast-Furnace and Coke Oven Association, U.S.A. The author is Vice President of the Freyn Engineering Company, Chicago.

The death of Mr. Robert Russell, late managing director of the Coltness Iron Company, Limited, Newmains, took place on February 1, in his 83rd year. Mr. Russell entered the employment of the company seventy years ago, and after serving for some time in the office he served his apprenticeship as a mining engineer.

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Trade Talk.

THE ADDRESS of Messrs. John Macdonald & Son, Limited, foundry engineers, is now Nitshill, near Glasgow.

THE employees of the Carron Company have made contributions to charitable institutions during 1928 to the total of £2,470 17s. 3d.

DAMAGE TO THE turning shop was caused by an outbreak of fire at the works of the Govan Shafting and Engineering Company, Glasgow.

IT IS REPORTED FROM Kimberley that British iron and steel interests have concluded an agreement with the Union Manganese Company for the development of the Postmasburg manganese-ore deposits.

MESSRS. LAWSON, WALTON & COMPANY, LIMITED, Foundry Equipment Suppliers, have taken over larger premises at 15-24, Handyside Arcade, Percy Street, Newcastle; more extensive stocks can now be carried, and loading facilities are greatly improved.

MESSRS. SWAN, HUNTER & WIGHAM RICHARDSON, LIMITED, have received an order from a Marseilles firm of shipowners for a cargo steamer of about 6,200 tons. The vessel is to be constructed at the builders' Southwick yard and engined at the Neptune works.

MESSRS. ALFRED HERBERT, LIMITED, announce that their American licensees, the Riley Stoker Corporation, have been awarded the order for four Atritor unit pulverisers for firing the boiler plant for the New Yorker Hotel which is being built in Broadway, and which will be the largest in the world.

THE BETHLEHEM STEEL CORPORATION has resumed dividend payments on the Common stock with a quarterly distribution of $1.00, the first since 1924. The report for the year ended December shows increases of $23,275,000 in gross sales, of $3,142,000 in total income and of $2,707,000 in the surplus.

MESSRS. ROBERT DUNCAN & COMPANY, LIMITED, have launched the cargo steamer, "Korano," which they have built for Jugo-Slavian owners. The vessel, which is 5,000 deadweight, is the first to be launched from Port Glasgow this year. Triple expansion engines will be supplied by Messrs. John G. Kincaid & Company, Limited, Greenock.

AN EXTRAORDINARY GENERAL MEETING of the Mond Nickel Company, Limited, has been held to approve alterations in the articles of association to facilitate the exchange of shares of the company into stock of the International Nickel Company of Canada, Limited. It was stated that 90 per cent. of the shareholders of both classes had assented to the exchange.

THE joint secretaries of the Scottish Manufactured Iron Trade Conciliation and Arbitration Board have been informed by Sir John M. MacLeod, C.A., Glasgow, that he has examined the books of the employers for November and December, 1928, and has certified that the average net selling price was £10 12s. 0.79d. This means that there will be no change in the wages of the operatives.

THE RESULT OF A BALLOT of members of the Sheffield Chamber of Commerce shows that 515 are in favour of the principle of the extension of safeguarding to the iron and steel industry and only 46 are against. From the iron and steel trade 208 members were in favour and 15 against, while from the cutlery, tools, silver and allied trades, the figures were 115 for and ten against.

MESSRS. C. & J. SVEDBERG (LONDON), LIMITED, Swedish iron merchants, announce that their business will in future be conducted from 30/32, Exchange Buildings, Stephenson Place, Birmingham. The name of the company is now C. & J. Svedberg, Limited, the word "(London)" having been deleted. Mr. G. J. E. Kjellberg has resigned his position as sole governing director of the company, and has been succeeded by Mr. W. T. Price.

THE AMALGAMATION of two old-established electrical engineering firms, Electromotors, Limited, of Manchester, and Laurence, Scott & Company, Limited, of Norwich, is announced. It is proposed that the new company will have the title of Laurence, Scott and Electromotors, Limited. The directors will include Mr. C. Wilson, chairman of Messrs. Laurence, Scott & Company, Limited, Mr. W. H. Scott, and Sir Benjamin Longbottom, managing director of Electromotors, Limited.

THE Staff Social Club of Messrs. R. & A. Main, Limited, Gothic Iron Works, Falkirk, held their annual "Burns' Night," on January 25. Mr. F. Binnie, president of the club, presided over an attendance of about eighty members and friends, and he was supported by Mr. A. P. Main, junior partner of the firm, Mr. G. W. Wortley, general manager, and Mrs. Wortley, and the Rev. J. A. F. Dean, of Erskine Church, Falkirk. Master William Potts piped in the haggis, while Master M'Lauchlan recited Burns' "Address to a Haggis." After supper, Rev. J. A. F. Dean proposed the "Immortal Memory," which was honoured in traditional fashion. Later a dance was held.

THE MOND-TURNER PROPOSALS for the establishment of a National Industrial Council of employers and employed have met with opposition from the British Engineers' Association, who have issued a lengthy memorandum setting forth their objections to the scheme. The Association particularly objects to the strong political character of the Trades Union Congress, whose representatives, they point out, would sit in conference with representatives of non-political employers' organisations, while, in any case, the Trades Union Congress represents only four million out of twelve million insured persons engaged in industry and trade. A meeting of the Grand Council of the Federation of British Industries is to be held on February 13 to consider the views of the British Engineers' Association and those of the other employers' associations who are members of the F.B.I.

THE SIXTH ANNUAL MEETING of the South Wales Siemens Steel Joint Conciliation Board was held at Swansea last week. Mr. Frank Rees, of the Llanelly Steel Company, Limited, was elected chairman of the employers' side, and Mr. John Hodge was elected chairman of the workmen's side. The Standing Joint Committee was reconstituted. In proposing the adoption of the annual report, Mr. Rees reviewed the conditions of the steel and tinplate industries in 1928, and made reference to the scrap position. In 1913, he said, we imported approximately 123,000 tons of scrap, and we exported 115,000 tons. In 1928 our imports had gone down to 57,000 tons, but our exports had gone up to 344,000 tons. Endeavours had been made to get the Government to intervene so far as the export of scrap was concerned, but owing to certain commercial treaties with Continental countries it was found that this could not be done, although Continental Governments would not allow scrap to go out of their own countries and small parcels could only be exported under permits.

AS A CONSEQUENCE of the dispute in the Scottish manufactured iron trade over 1,500 men at Coatbridge, Airdrie and Motherwell have been idle this week. The employers asked for an extension of the working hours and a reduction in the wage rate, and intimated that work would not be resumed this week except on the new terms. Two firms, however, Messrs. David Colville & Sons, Limited, and Messrs. Smith & Maclean, Limited, have not posted notices, and work has been resumed at these establishments under the old agreement. In the course of correspondence with the Iron and Steel Trades Confederation, the employers stated their conviction that "the issue is whether the industry will practically cease in Scotland, or will take immediate steps to effect an improvement on the position which would secure the employment of the men presently employed, and hold out some hope of re-employment for those out of work." They maintain that in view of the state to which the wrought-iron industry in Scotland has been brought, it is necessary to have a two-shift system of working with reduced costs in forges and mills producing wrought iron.

Company Meetings.

Coventry Gauge and Tool Company (1928), Limited.—The statutory meeting was held last week in London, MR. S. C. TREFUSIS (the chairman), who presided, said that the erection of the new factory extension was nearing completion, and they hoped to have installed the bulk of the new machinery by the middle of February. Business continued to expand on a very satisfactory scale. Although the turnover last year was the highest in the history of the business, the work in hand at the present time surpassed all records of the factory during the 15 years of its existence. They had every confidence that the new factory would be fully employed from the time of its completion.

Kerr, Stuart & Company, Limited.—The annual meeting was held on Monday in London. MR. H. LANGHAM REED (chairman and managing director) said that the conditions prevailing in the locomotive industry had been so depressed that it had been impossible for the company to secure orders of any magnitude at remunerative prices. In view of the intense competition for orders of the heavier type of locomotives, they had concentrated their efforts on introducing a new type of light Diesel locomotive and a geared steam locomotive. There was a large field for both new types, and their reception had been most encouraging. The general engineering branch of the company's business had been completely reorganised. Low-Temperature Carbonisation, Limited, in which the company had a large holding, had made substantial progress during the past year. Kerr, Stuart & Company, having specialised in the manufacture of low-temperature plants, were able to secure orders in open competition, and he believed this class of business would establish a line of profitable new work for the company.

Contracts Open.

Belfast, February 9. — Permanent-way cast-iron chairs, steel castings, etc., for the L.M. and S.R. Northern Counties Committee (Ireland). Mr. J. Martin, stores superintendent, York Road Station, Belfast.

Dublin, February 11.—Cast-iron pipes, castings and valves, for the Borough Commissioners. The Supplies Department, Lord Edward Street. (Fee 1s.)

Leeds, February 15.—Castings, bolts, nuts and screws, gas and steam tubes, lead tubing, etc., for the Electricity Department. Mr. C. N. Hefford, Electricity Department, 1, Whitehall Road, Leeds.

Stoke-on-Trent, February 13.—Steam and water piping, valves, etc., for the Town Council. The City Electrical Engineer, St. George's Chambers, Kingsway, Stoke-on-Trent. (Fee £2, returnable.)

Dunedin, N.Z., March 20.—Tramway equipment, for the Dunedin City Tramway Department. The Department of Overseas Trade. (Reference A.X. 7441.)

Hamilton, Ontario, February 20.—Three horizontal booster pumps, for the City of Hamilton, Ontario. The Department of Overseas Trade. (Reference A.X. 7428.)

Johannesburg, March 7.—Hydraulic accumulator, horizontal ram pump, electric motor, air compressor, etc., for the South African Railways and Harbours (Tender No. 1398). The Department of Overseas Trade. (Reference A.X. 7414.)

Melbourne, April 29.—Two swing hammer mills, with electric motors, for brown coal, for the State Electricity Commission of Victoria (Specification No. 29/9). The Department of Overseas Trade. (Reference A.X. 7434.)

North Shields, February 18.—1½-ton portal electric travelling level luffing crane, for the Tyne Improvement Commissioners. Mr. A. Blacklock, secretary, Bewick Street, Newcastle-on-Tyne. (Fee £1 1s., returnable.)

Riga, February 12.—Hawser excavator, caterpillar type, for the Latvian Agricultural Department. The Department of Overseas Trade. (Reference A.X. 7405.)

Warrington, February 9.—Horizontal electrically-driven centrifugal pump, for the Water Committee. Mr. J. Gray, Water Engineer's Office, Warrington.

Wellington, Salop, February 14.—Pumps and gas engines, also fire escapes, for the Poor Law Institution. Mr. R. Gwynne, clerk, Edgbaston House, Wellington, Salop.

Windhoek, S.W. Africa.—Jib crane, for the Director of Works at Windhoek, South-West Africa. The Department of Overseas Trade. (Reference A.X. 7415.)

Obituary.

MR. ALFRED HEATH, of Messrs. Samuel Heath & Sons, Limited, brassfounders, Birmingham, died recently at the age of 88 years.

MR. JOHN P. KINGHORN, J.P., of Messrs. John P. Kinghorn & Company, iron-ore importers and pig-iron merchants, Glasgow, died on Monday, January 28.

MR. T. W. ALSOP, a director of the Falkirk Iron Company, Limited, and chairman of the James Keith & Blackman Company, Limited, has died at the age of 73.

MR. RUDOLPH MUSPRATT, only son of Sir Max Muspratt, Bt., who died in Liverpool on Monday, at the age of 24, was associated with the Imperial Chemical Industries, Limited, at Widnes.

COLONEL H. J. WALDUCK, chairman of Messrs Ludlow Brothers (1913), Limited, Birmingham, died last week at Colombo, where he had been engaged on a business mission. Colonel Walduck was for some years chairman of the Wrought Hollow-Ware Manufacturers' Association, and he had been chairman of the Wrought Hollow-Ware Trade Board since its formation in 1914. He was a past-President of the Birmingham Chamber of Commerce, and last year was chairman of the British Industries Fair Management Committee.

Personal.

MR. R. CARPNAEL has been appointed chief engineer of the Great Western Railway Company.

MR. W. PARKER has joined Premix Gas Plants, Limited, as sales engineer. Mr. Parker has had 12 years' experience with Messrs. Siemens Bros. & Company, Limited, as a chief works engineer and general manager. Recently he returned from an extensive tour in the United States.

Will.

COLLINGWOOD, SIR W., K.B.E., J.P., of Dedham Grove, Colchester, and of Newton-le-Willows, Lancs, for many years managing director of the Vulcan Foundry, Newton-le-Willows £123,765

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COAL DUST.

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Approximate Analyses of SHOTTS PIG IRON

FOUNDRY, FORGE AND CYLINDER QUALITIES.

	Iron. %	Graphitic Carbon. %	Combined Carbon. %	Silicon. %	Sulphur. %	Phos. %	Mang. %
No. 1	91.23	3.55	.25	3.25	.02	.50	1.20
No. 3 Soft	91.78	3.45	.30	2.80	.02	.50	1.15
No. 3 Medium	92.25	3.35	.37	2.40	.03	.50	1.10
No. 3 Hard	92.71	3.20	.45	2.10	.04	.50	1.00
No. 4 Soft	93.19	3.15	.45	1.70	.06	.50	.95
No. 4 Hard	93.74	2.85	.63	1.35	.08	.50	.85
Cylinder Iron	93.84	2.65	.67	1.50	.09	.40	.85
High Duty	92.95	2.90	.68	1.60	.07	.35	1.45
Low Phosphorus	92.73	3.30	.45	2.50	.03	.14	.85
Mottled	94.25	2.00	1.50	.90	.15	.50	.70
White	94.75	.60	2.80	.50	.25	.50	.60

Compositions other than the above regularly made to Customer's requirements.

In addition to PIG IRON, we are Producers of the following:—

Blast Furnace Pitch, Creosote, and Sulphate of Ammonia.
Limestone for foundry use.
"Shotts" Brick for Building purposes.
Coal for Steam, Gas, and Household purposes.
Lime for Building, Agricultural purposes, &c.
Slag for Ballasting and Road Making broken to sizes to suit purchasers.

Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—Conditions in the Cleveland iron market remain so far satisfactory, inasmuch that furnace outputs in the Tees-side area are fully absorbed in meeting requirements of local steel plants, but still without signs of expansion in the demands for foundry pig. The slightly accelerated activity in the home consumption comes concurrently with a welcome increase in shipments from Tees-side ports, the total for January up to the 29th inst. having been 16,038 tons, compared with 13,746 tons to December 29. It is, however, a more hopeful sign of future progress that additional furnaces are shortly to be relighted in the district, from which it may fairly be deduced that the industrial outlook is brightening, but the fly in the ointment is that pig-iron production in Cleveland is still an unattractive proposition, makers affirming that there is little or no margin of profit. The only price concession which is being made is a rebate of 1s. per ton on 2,000-ton lots, leaving quotations as follow:—No. 1 Cleveland foundry iron, 68s. 6d. per ton; No. 3 G.M.B., 66s.; No. 4 foundry, 65s.; No. 4 forge, 64s. 6d. per ton.

On the principle that "what is lost on the swings is gained on the roundabouts," the hematite section of the Tees-side industry, thanks to increasing activity in the steel trade, is experiencing a miniature boom; makers, though, like the pig-iron producers, complaining of unremunerative prices, are indisposed at the moment to make an attempt to alter present terms of sale. Most of the makers on the North-East Coast are now well sold for February, and inquiries for March are also coming along. Thus, 71s. 6d. per ton has become a minimum price for mixed numbers and 72s. for No. 1 quality.

LANCASHIRE.—Consumers of foundry pig in this area have recently been disturbed by the concerted action of the Midland ironmasters to stiffen prices, the initial step having been made by a Staffordshire firm, and has since been followed by other prominent producers. The difficulties of the position may be gauged from the fact that, while leading Derbyshire brands are quoted about 69s. for local deliveries, others are asking from 70s. to 72s. 6d. per ton, while Scottish qualities now command from 89s. to 90s. per ton delivered in this area.

THE MIDLANDS.—Ironfounders in the Black Country districts continue buying in the market on a hand-to-mouth scale, forward business in this direction being still restricted in volume, although trade on the whole may be regarded as slightly improved. In the meantime, prices are about maintained at the following levels:—Northants. No. 3, 57s. 6d.; Derbyshire, equal quality, 62s.; and North Staffordshire, 65s. per ton, all f.o.t. at furnaces.

SCOTLAND.—At a conference of Scottish pig-iron producers recently, it was decided to advance prices, making the general quotation for No. 3 foundry 71s. per ton f.o.t. furnaces. This advance is not due to any better demand, but is the result of the various makers coming to the decision that they cannot go on any longer selling pig-iron at an unremunerative price, and they have decided, by putting 1s. on the quotation, to reduce their loss to this extent.

Finished Iron.

The position in this market discloses little improvement in conditions generally, but, as indicated previously, some works are finding slightly more business developing for crown iron, while little support is being given to the local works for nut and bolt iron, as foreign competition is still being felt very severely in this direction. The Staffordshire price for this class of iron varies at from £8 10s. to £8 17s. 6d., whereas the Belgian product can be obtained at £7 2s. 6d. to £7 5s., delivered in the Darlaston area. There has been no change in the price of marked bars, the figure for which is £12 per ton at makers' works. These mills continue to be fairly well occupied.

Scrap.

Reports from the various consuming districts for this class of foundry material indicate that on Tees-side there is a marked shortage of supplies of iron and steel scrap, and it looks very probable that prices will move up rapidly, though the demand for heavy cast iron is quiet, and prices are unchanged at 61s. for ordinary quality and 65s. for machinery quality in handy sizes. At Birmingham the improved demand for cast-iron scrap recently reported has been maintained. For heavy machinery cast-iron scrap 65s. delivered is quoted, and 55s. delivered for light quality. In Scotland the cast-iron scrap market shows a slight increase of business, with good prices ruling. First-class machinery cast-iron scrap, suitable for foundry cupolas, is quoted 67s. to 67s. 6d., and for clean heavy quality 62s. 6d. is quoted. Old cast-iron railway chairs are 66s. 6d. to 67s. The demand for light cast-iron scrap is maintained at 58s. 6d. to 59s. The above prices are all per ton, delivered f.o.t. consumers' works.

Steel.

At Sheffield this week markets for steel continue inactive, and no improvement is to be noted in the demand for Siemens acid steel billets, but basic qualities, the buying of which has been on the up-grade for some time past, have been advanced in price by from 2s. 6d. to 7s. 6d. per ton. Hard basic billets are now quoted at £7 5s., £7 15s. and £8 15s. per ton. Soft basic billet prices were advanced some time ago. The general demand for finished steel continues active, and most of the British works are fairly well off for orders. The export demand remains irregular, but of late inquiry has increased, and it is anticipated that foreign buyers will shortly be in the market again. The tone of the tinplate market is steady, and makers are firm in their quotations of 18s. to 18s. 3d. basis for coke quality, net cash, f.o.b. Welsh ports.

Metals.

Copper.—In the week's markets for base metals increasing strength has again been disclosed in the position of warrant copper, which at last week's close was 30s. up on quotation for the previous corresponding period. These conditions have been largely influenced by the optimistic trade reports received from America. Demand from consumers has been good, and business has been freely contracted for on forward account. Although satisfactory at the moment, it is to be feared that demand will slacken off considerably on reaching the period when these demands have been satisfied.

Closing quotations are:—

Cash.—Thursday, £77 17s. 6d. to £78; Friday, £78 10s. to £78 12s. 6d.; Monday, £80 10s. to £80 15s.; Tuesday, £80 10s. to £80 12s. 6d.; Wednesday, £80 2s. 6d. to £80 5s.

Three Months.—Thursday, £75 6s. 3d. to £75 7s. 6d.; Friday, £76 2s. 6d. to £76 5s.; Monday, £77 12s. 6d. to £77 15s.; Tuesday, £78 7s. 6d. to £78 8s. 9d.; Wednesday, £77 15s. to £77 17s. 6d.

Tin.—Although fluctuations in standard tin during the past week have been unimportant in compass, the general tone of markets has been steady on the whole, if inclined to a quieter tendency. The situation, taken as a whole, has changed very little, with the fundamental conditions still the same. Consumers who have been standing aloof for some time past are bound to enter the market sooner or later, thus easing the burden of the "group," on whom at present the whole market depends.

Official closing prices:—

Cash.—Thursday, £220 to £220 2s. 6d.: Friday, £220 7s. 6d. to £220 10s.; Monday, £223 to £223 5s.: Tuesday, £228 to £228 5s.; Wednesday, £229 10s. to £230.

Three Months.—Thursday, £221 2s. 6d. to £221 5s.: Friday, £221 7s. 6d. to £221 10s.; Monday, £224 2s. 6d. to £224 5s.; Tuesday, £228 5s. to £228 10s.; Wednesday, £229 10s. to £230.

Spelter.—Consumptive demand for ordinary spelter in this country has been quiet recently, although Continental advices report rather firmer conditions. Prices started somewhat irregularly, but recovered later in the presence of a fair volume of buying.

Daily quotations are:—

Ordinary.—Thursday, £26 5s.; Friday, £26 5s.; Monday, £26 8s. 9d.; Tuesday, £26 7s. 6d.; Wednesday, £26 7s. 6d.

Lead.—The market for soft foreign pig remains dull and quiet, with demand from consumers generally very slow. Prices were at first irregular, but recovered later. It is generally assumed that consumers are not too well covered for forward requirements, so that increased activity and higher prices are likely to materialise in the near future.

Prices have been:—

Soft Foreign Prompt.—Thursday, £22 3s. 9d.; Friday, £22 6s. 3d.; Monday, £22 8s. 9d.; Tuesday, £22 10s.; Wednesday, £22 16s. 3d.

Students' Corner.

Q.—What are the functions of blackings and gums?

A.—Foundry blackings include charcoal, plumbago and graphite. All of these are generally prepared as a compound, but they are carbon in a more or less pure state, as they are delivered to the foundry. The price is the best guide to its purity.

Charcoal blacking is made from wood which has had the volatile matter burnt out of it; it is then ground into powder, after which it is very light, and mixes with water, or claywash without any difficulty.

Plumbago is a mineral blacking, as is also graphitic-carbon, or, as it is sometimes called, blacklead. This latter is often used for dusting moulds, or rubbed on the surface of the moulds in a dry state. The specific gravity of these vary considerably.

Composition blackings are proprietary mixtures, and have probably the nearest ideal specific gravity for mixing, i.e., density of water. Blackwash for coating dry-sand and loam moulds is a mixture of blacking, claywash or gum, and of course water. The claywash, or gum, is the bond in the black-wash mixing. The blacking, when used in the wet state, requires some bond in the same way as the sands.

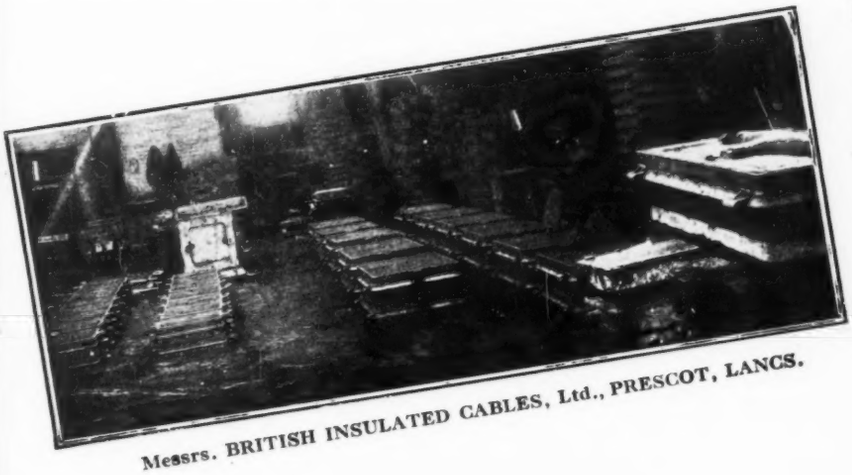
Claywash is common clay mixed with water, the claywash may be mixed weak or strong, or, in other words, thin or thick. For light work thin claywash is used, whilst for heavy work thick claywash is normal practice. This is generally mixed in an iron tank, and it is not easy to put into words the percentage of clay or water, but roughly the amount of clay is 5 per cent. water and 95 per cent. for thin castings, and 10 per cent. clay, 90 per cent. water for thick castings. Gum, which is supplied in a dry powder form, may be used in the same proportions, but the gum—to obtain its full benefit—should be mixed with hot water, which will partly dissolve it, thus bringing out its bonding, and colloidal nature.

If the blacking were mixed with water only, the blackwashed surface of the mould, or core when dried, would lack hardness, and bond, so much so that it could be rubbed off the mould or core quite easily by the hand. Also it would be liable to erosion by the passage of the fluid iron when pouring. The claywash acts as a binder to the blacking. The clay itself is also of a highly refractory nature. The gum also acts as a bond, but is not of such a refractory nature as common clay. The high refractoriness of the carbon blacking, coupled with the clay as a bond, resists the high temperature of the metal in relation to fusibility of the mould, and leaves a clean blue skin upon the casting. These are the two chief reasons why it is used.

Blackwash, of course, is only used for dry-sand work and loam work, both moulds and cores. If the blackwash in either when dried shows signs of peeling, this indicates that the claywash is too strong. On the other hand, if the casting shows excessive erosion, and does not give a clean skin, it indicates that the blacking has been too weak. The proportion of blacking to water depends to some extent on what it is required to do, but roughly, if the blacking mixture with its water-clay and dryblacking, is mixed to a consistency of thin cream, it would not be very far wrong. The choice between clay and gum as a bond is much in favour of clay. Also, it is economical.

THESE IMPORTANT FOUNDRIES USE Sterling ROLLED STEEL BOXES

Messrs. HENRY WALLWORK & Co. (1920) Ltd., MANCHESTER



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THEY SAVE LABOUR, SPEED UP PRODUCTION, PRODUCE MORE ACCURATE CASTINGS AND MAKE FOR ALL-ROUND EFFICIENCY.

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WEEKLY PRICE CURRENT.

COPPER.

	£ s. d.
Standard cash	80 2 6
Three months	77 15 0
Electrolytic	81 15 0
Tough	80 5 0
Best selected	80 10 0
Sheets	104 0 0
India	89 5 0
Wire bars	80 17 6
Do. February	80 17 6
Do. March	80 17 6
Ingot bars	80 17 6
H.C. Wire rods	85 15 0
Off. av. cash, January	75 11 11
Do. 3 mths., January	73 14 10
Do., Sttlmnt., January	75 12 1
Do., Electro, January	78 17 0
Do., B.S., January	77 12 6
Aver. spot price, copper, Jan.	75 11 11
Do. Wire bars, January	79 2 0
Solid drawn tubes	14½d.
Brazed tubes	14½d.
Wire	10½d.

BRASS.

Solid drawn tubes	12½d.
Brazed tubes	14½d.
Rods, drawn	11⅞d.
Rods, extd. or rlld.	7½d.
Sheets to 10 w.g.	11½d.
Wire	10½d.
Rolled metal	10½d
Yellow metal rods	7½d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets	8½d.

TIN.

	£ s. d.
Standard cash	229 10 0
Three months	229 10 0
English	230 0 0
Bars	230 0 0
Straits	235 10 0
Australian	—
Eastern	228 10 0
Banca	231 5 0
Off. av. cash, January	222 16 3
Do., 3 mths., January	222 14 1
Do., Sttlmt., January	222 15 10
Aver. spot, January	222 16 3

SPELTER.

	£ s. d.
Ordinary	26 7 6
Remelted	25 0 0
Hard	20 0 0
Electro 99.9	29 10 0
English	26 15 0
India	21 15 0
Zinc dust	(Nom.) 36 10 0
Zinc ashes	8 5 0
Off. aver., January	26 4 3
Aver., spot, January	26 3 11

LEAD.

	£ s. d.
Soft foreign ppt.	22 16 3
English	24 0 0
Off. average, January	22 4 6
Average spot, January	22 2 2

ZINC SHEETS, &c.

	£ s. d.
Zinc sheets, English	34 0 0
Do. V.M. ex whf.	33 5 0
Rods	44 0 0
Boiler plates	32 0 0
Battery plates	32 15 0

ANTIMONY.

	£ s. d.
Special brands, Eng.	54 10 0
Chinese	38 0 0
Crude	33 10 0

QUICKSILVER.

	£ s. d.
Quicksilver	22 5 9

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—	
25%	£7 17 6
45/50%	£12 0 0
75%	£19 0 0
Ferro-vanadium—	
35/50%	13/9 lb. Va.
Ferro-molybdenum—	
70/75% c. free	3/9 lb. Mo.
Ferro-titanium—	
23/25% carbonless	1/- lb.
Ferro-phosphorus, 20/25%	£18 0 0
Ferro-tungsten—	
80/85%, c. fr.	1/6½ lb.
Tungsten metal powder—	
98/99%	1/10½ lb.
Ferro-chrome—	
2/4% car.	£30 15 0
4/6% car.	£21 15 0
6/8% car.	£20 17 6
8/10% car.	£20 10 0
Ferro-chrome—	
Max. 2% car.	£33 5 0
Max. 1% car.	£36 0 0
Max. 0.70% car.	£44 0 0
70% carbonless	1/- lb.
Nickel—99% cubes or pellets	£175 0 0
Ferro-cobalt	9/- lb.
Aluminium 98 99%	£95 0 0
Metallic chromium—	
96/98%	2/6 lb.
Ferro-manganese (net)—	
76/80% loose	£13 15 0
76/80% packed	£14 15 0
76/80%, export	£14 10 0
Metallic manganese—	
94/96%, carbonless	1/6 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	£0 2 0
Finished bars, 18% tungsten	£0 2 9

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to ⅛ in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ¼ in.	3d. lb
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£ s. d.
South Wales—	
Hvy. steel	3 10 0
Bundled steel and shrngs.	3 5 0 to 3 9 0
Mixed iron and steel	3 5 0
Heavy cast iron	2 18 0 to 3 0 0
Good machinery for foundries	3 0 0
Cleveland—	
Heavy steel	3 4 6
Steel turnings	2 8 6
Cast iron borings	2 4 0
Heavy forge	3 7 6
W.I. piling scrap	3 0 0
Cast-iron scrap	3 1 0 to 3 5 0
Lancashire—	
Cast-iron scrap	2 15 0 to 3 5 0
Hvy. wrought	3 11 6
Steel turnings	2 7 0
Scotland—	
Heavy steel	3 7 6 to 3 10 0
Cast-iron borings	2 12 6
Wrought-iron piling	3 7 6
Heavy machinery	3 8 6

London—Merchants' buying prices delivered yard.

	£ s. d.
Copper (clean)	57 0 0
Brass	39 0 0
Lead (less usual draft)	19 0 0
Tea lead	16 0 0
Zinc	16 10 0
New aluminium cuttings	67 0 0
Braziery copper	52 0 0
Gunmetal	55 0 0
Hollow pewter	150 0 0
Shaped black pewter	105 0 0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	68/6
Foundry No. 3	66/-
Foundry No. 4	65/-
Forge No. 4	64/6
Hematite No. 1	72/-
Hematite M/Nos.	71/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	78/-
,, d/d Birm.	85/6
Midlands—	
Staffs. common*	72/6
,, No. 4 forge	60/-
,, No. 3 fdry.	65/-
Shrops. basic	—
,, Cold blast, ord.*	—
,, ,, roll iron*	—
* d/d Birmingham.	
Northants forge	52/-
,, fdry. No. 3	57/6
Derbyshire forge	59/-
,, fdry. No. 3	60/-
,, basic	65/-
Scotland—	
Foundry No. 1	76/-
,, No. 3	71/-
Hem. M/Nos.	75/-
Sheffield (d/d district)—	
Derby forge	61/6
,, fdry. No. 3	64/-
Lincs. forge	62/6
,, fdry. No. 3	65/6
E.C. hematite	81/-
W.C. hematite	83/6
Lincs. (at furnaces)—	
Forge No. 4	58/-
Foundry No. 3	61/-
Basic	61/-
Lancashire (d/d eq. Man.)—	
Derby forge	—
,, fdry. No. 3	69/- to 71/-
Northants foundry No. 3	—
Dalzell, No. 3(special)	100/- to 102/6
Summerlee, No. 3	89/- to 90/-
Glengarnock, No. 3	89/- to 90/-
Gartsherrie, No. 3	89/- to 90/-
Monkland, No. 3	89/- to 90/-
Shotts, No. 3	89/- to 90/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£ s. d.	£ s. d.
Bars (cr.) nom.		10 5 0
Nut and bolt iron	8 10 0 to 8	17 6
Hoops		11 10 0
Marked bars (Staffs.) f.o.t.		12 0 0
Gas strip		11 10 0
Bolts and nuts, ¾ in. × 4 in.		15 5 0
Steel—		
Ship plates	8 7 6 to 8	12 6
Boiler plts.		10 10 0
Chequer plts.		10 12 6
Angles		7 17 6
Tees		8 17 6
Joists		7 17 6
Rounds and squares, 3 in. to 5½ in.		8 17 6
Rounds under 3 in. to ¼ in. (Untested)		7 15 0
		and upwards
Flats, over 5 in. wide and up		8 7 6
Flats, 5 in. to 1½ in.		7 17 6
Rails, heavy		8 10 0
Fishplates		12 10 0
Hoops (Staffs.)		10 10 0
Black sheets, 24g.	10 0 0 to 10	10 0
Galv.cor.shts.,24g.	13 10 0 to 13	15 0
Galv. fencing wire 8g. plain		12 10 0
Billets, soft	6 5 0 to 6	12 6
Billets, hard	7 7 6 to 7	15 0
Sheet bars		6 0 0
Tin bars		8 0 0

PHOSPHOR BRONZE.

	Per lb. basis
Strip	1 3½
Sheet to 10 w.g.	1 3¾
Wire	1 5
Rods	1 3½
Tubes	1 8½
Castings	1 2½

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3½ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks	9d. to 1/5½
Ingots rolled to spoon size	1/- to 1/8½
Wire round—	
3/0 to 10 G.	1/6½ to 2/1½

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2X foundry, Phila.	21.26
No. 2 foundry, Valley	18.00
No. 2 foundry, Birm.	16.50
Basic	19.26
Bessemer	20.79
Malleable	20.01
Grey forge	19.26
Ferro-mang. 80% d/d	105.00
O.-h. rails, h'y at mill	43.00
Bess billets	33.00
O.-h. billets	33.00
O.-h. sheet bars	34.00
Wire rods	42.00
	Cents.
Iron bars, Phila.	2.12
Steel bars	1.95
Tank plates	1.90
Beams, etc.	1.90
Skelp, grooved steel	1.90
Skelp, sheared steel	1.90
Steel hoops	2.20
Sheets, black, No. 24	2.85
Sheets, galv., No. 24	3.60
Sheets, blue an'l'd, 9 and 10	2.10
Wire nails	2.65
Plain wire	2.50
Barbed wire, galv.	3.30
Tinplates, 100 lb. box	$5.35

COKE (at ovens)

Welsh foundry	25/- to 30/-
,, furnace	19/- to 23/-
Durham and North.	
,, foundry	16/-
,, furnace	15/6
Midlands, foundry	—
,, ,, furnace	14/-

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes	20 × 14 box	18/-
,,	28 × 20 ,,	36/-
,,	20 × 10 ,,	26/3
,,	18¾ × 14 ,,	18/9
C.W.	20 × 14 ,,	15/-
,,	28 × 20 ,,	33/6
,,	20 × 10 ,,	21/3
,,	18¾ × 14 ,,	15/-
Terneplates	28 × 20	33/6 per box basis f.o.b.

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6 0 0 to £7 10 0
Bars, hammered, basis	£17 10 0 to £18 10 0
Bars & nailrods, rolled, basis	£15 15 0 to £16 15 0
Blooms	£10 0 0 to £12 0 0
Keg steel	£32 0 0 to £33 0 0
Faggot steel	£20 0 0 to £24 0 0
Bars & rods, dead soft, steel	£10 0 0 to £14 0 0

All per English ton f.o.b. Gothenburg

TUBES AND FITTINGS.

Up to and incl. 6 in.

	Tubes.	Fittings.
Gas	67½%	50%
Water	63½%	45%
Steam	60%	40%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£ s. d.	
Jan. 31 ..	77 17 6	inc. 11/3
Feb. 1 ..	78 10 0	,, 12/6
,, 4 ..	80 10 0	,, 40/-
,, 5 ..	80 10 0	No change
,, 6 ..	80 2 6	dec. 7/6

Electrolytic Copper.

	£ s. d.	
Jan. 31 ..	79 10 0	No change
Feb. 1 ..	79 15 0	inc. 15/-
,, 4 ..	80 15 0	,, 20/-
,, 5 ..	81 0 0	,, 5/-
,, 6 ..	81 15 0	,, 15/-

Standard Tin (cash).

	£ s. d.	
Jan. 31 ..	220 0 0	dec. 2/6
Feb. 1 ..	220 7 6	inc. 7/6
,, 4 ..	223 0 0	,, 52/6
,, 5 ..	228 0 0	,, 100/-
,, 6 ..	229 10 0	,, 30/-

Tin (English ingots).

	£ s. d.	
Jan. 31 ..	220 0 0	dec. 5/-
Feb. 1 ..	220 10 0	inc. 10/-
,, 4 ..	223 0 0	,, 50/-
,, 5 ..	228 0 0	,, 100/-
,, 6 ..	230 0 0	,, 40/-

Zinc Sheets (English).

	£ s. d.	
Jan. 31 ..	34 0 0	No change
Feb. 1 ..	34 0 0	,, ,,
,, 4 ..	34 0 0	,, ,,
,, 5 ..	34 0 0	,, ,,
,, 6 ..	34 0 0	,, ,,

Spelter (ordinary).

	£ s. d.	
Jan. 31 ..	26 5 0	inc. 2/6
Feb. 1 ..	26 5 0	No change
,, 4 ..	26 8 9	inc. 3/9
,, 5 ..	26 7 6	dec. 1/3
,, 6 ..	26 7 6	No change

Lead (English).

	£ s. d.	
Jan. 31 ..	23 10 0	No change
Feb. 1 ..	23 15 0	inc. 5/-
,, 4 ..	23 15 0	No change
,, 5 ..	23 15 0	,, ,,
,, 6 ..	24 0 0	inc. 5/-

AVERAGE PRICES OF GALVANISED CORRUGATED SHEETS (NORTH OF ENGLAND).

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1902.....	12 0 0	11 10 0	11 10 0	11 10 0	11 15 0	11 15 0	11 15 0	11 15 0	11 15 0	11 15 0	11 15 0	11 15½ 0	11 14 2
1903.....	11 5 0	11 5 0	11 5 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 5 0	11 5 0	11 5 0	11 5 0	11 7 1
1904.....	11 5 0	11 5 0	11 5 0	11 5 0	10 15 0	10 15 0	10 15 0	10 15 0	10 5 0	10 5 0	10 5 0	10 5 0	10 15 0
1905.....	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	11 0 0	11 5 0	11 15 0	12 0 0	10 15 0
1906.....	12 12 6	12 12 6	12 12 6	12 7 6	12 7 6	12 7 6	12 12 6	12 12 6	12 15 0	12 15 0	12 15 0	13 5 0	12 12 11½
1907.....	13 5 0	13 5 0	13 15 0	13 15 0	13 15 0	13 15 0	13 17 6	13 17 6	13 17 6	13 2 6	13 2 6	13 2 6	13 10 10
1908.....	13 2 6	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 11 0½
1909.....	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	10 10 0	11 0 0	11 0 0	11 0 0	11 0 0	11 16 8
1910.....	11 15 0	12 5 0	12 5 0	11 15 0	11 10 0	11 10 0	11 12 6	11 12 6	11 12 6	11 12 6	11 10 0	11 10 0	11 13 4
1911.....	11 5 0	11 1 3	10 15 0	10 15 0	10 13 9	10 10 0	10 13 9	11 0 0	11 5 0	11 5 0	11 5 0	11 7 0	10 19 7½
1912.....	11 10 0	11 10 0	11 10 0	11 15 0	12 5 0	12 5 0	12 5 0	12 5 0	12 5 0	12 12 6	12 18 0	12 15 0	12 2 11½
1913.....	12 15 0	12 15 0	12 15 0	12 11 3	11 18 0	11 15 0	11 15 0	11 15 0	11 15 0	11 3 0	11 0 0	11 2 6	11 18 4
1914.....	11 7 0	11 7 6	11 7 6	11 5 7½	11 2 6	10 15 0	10 15 0	12 17 6	14 2 0	13 7 0	11 15 7	11 2 6	11 16 0
1915.....	11 10 8½	13 12 6	14 8 9	15 0 6	17 17 6	20 17 6	20 17 6	20 6 3	17 12 6	18 1 0	22 13 9	25 2 0	18 3 4½
1916.....	26 5 0	27 12 6	28 0 0	28 5 0	29 0 0	29 0 0	28 15 0	28 3 0	28 15 0	28 15 0	28 15 0	28 15 0	28 6 8½
1917.....	28 15 0	28 15 0	28 15 0	28 15 0	28 15 0	28 15 0	28 15 0	28 15 0	28 15 0	28 0 0	28 0 0	28 0 0	28 11 3
1918.....	28 5 0	28 15 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	28 13 4
1919.....	29 0 0	29 0 0	29 0 0	28 0 0	28 10 0	27 7 6	27 5 0	29 3 0	32 0 0	33 0 0	36 10 0	40 8 4	31 5 3½
1920.....	46 10 0	49 15 0	53 15 0	56 0 0	55 10 0	54 10 0	52 10 0	48 10 0	44 3 4	39 2 6	35 17 6	30 8 0	47 4 3
1921.....	28 10 0	25 17 6	24 5 0	23 3 4	22 0 0	22 0 0	23 10 0	21 12 6	20 0 0	18 15 0	18 3 9	17 2 0	22 1 7
1922.....	16 17 6	15 13 9	16 3 0	16 10 0	16 4 4½	15 15 6	15 16 3	16 16 0	16 8 9	16 6 3	17 1 0	17 7 6	16 7 5½
1923.....	18 3 1½	19 1 11½	19 8 0	19 10 0	19 7 0	19 1 3	18 0 0	18 13 1½	19 0 0	19 3 9	19 2 6	18 19 4½	18 19 2
1924.....	18 13 6	18 9 4½	18 5 0	17 15 11½	17 3 0	17 19 4½	18 7 6	18 8 1½	18 8 1½	17 19 6	17 11 3	17 10 0	18 0 10½
1925.....	17 8 6	17 1 6½	16 9 4½	16 12 0	16 9 8½	16 9 4½	16 0 6	16 1 10½	16 5 0	16 7 0	16 12 6	16 15 0	16 11 0½
1926.....	16 14 4½	16 5 7½	16 0 6	15 11 10½	15 11 3	16 0 0	16 16 0	16 18 9	16 14 0	16 18 9	17 10 0	16 19 0	16 10 0½
1927.....	16 3 1	15 7 6	15 3 3	15 3 1½	14 14 4½	14 11 6	14 1 10½	14 0 0	13 19 6	13 16 10½	13 13 1½	13 3 9	14 9 10
1928.....	13 0 0	13 2 6	13 6 0	13 2 6	13 3 0	13 6 9	13 11 3	13 10 0	13 10 7½	13 12 6	13 11 6	13 10 0	13 8 8½
1929.....	13 10 7½	—	—	—	—	—	—	—	—	—	—	—	—

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(A remittance should accompany instructions.)

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TECHNICAL ASSISTANT.—Well-educated Foundryman, age 23, desires progressive situation; first-class training in grey iron metallurgy, knowledge of metallography, cupola practice, etc.; six years' practical foundry experience in various branches.—Box 984, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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Continued.

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Agreement for five years in the first instance. The scale of pay applicable to both appointments is Rs. 500, rising by annual increments of Rs. 50 to Rs. 750 a calendar month, with a personal allowance of Rs. 200 a month and certain other allowances. The selected candidates will be granted a commencing rate of pay within this scale commensurate with their age and qualifications. Free first-class passage to India. Provident Fund.

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THE proprietor of British Patent No. 244,315, dated March 30, 1925, relating to "Sand Moulding Machines," is desirous of entering into arrangements by way of a licence or otherwise on reasonable terms for the purpose of exploiting the above patent and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois.

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'Phone: 287 SLOUGH.

MOULDING MACHINES

ONE 18"×18" Tabor Split pattern ..	£70
Two 40"×30" Tabor Shockless rollover	£160 each
12" Shockless plain jolter, 72"×60" table	£140
Two Bonvillain machines (24" dia. boxes)	£120
Four No. 0 Britannia jolters	£20 each
One 24"×48" Tabor Shockless rollover	£140
One 18"×36" Tabor Shockless rollover	£110
Twelve Adaptable Moulding Machines	£16 each

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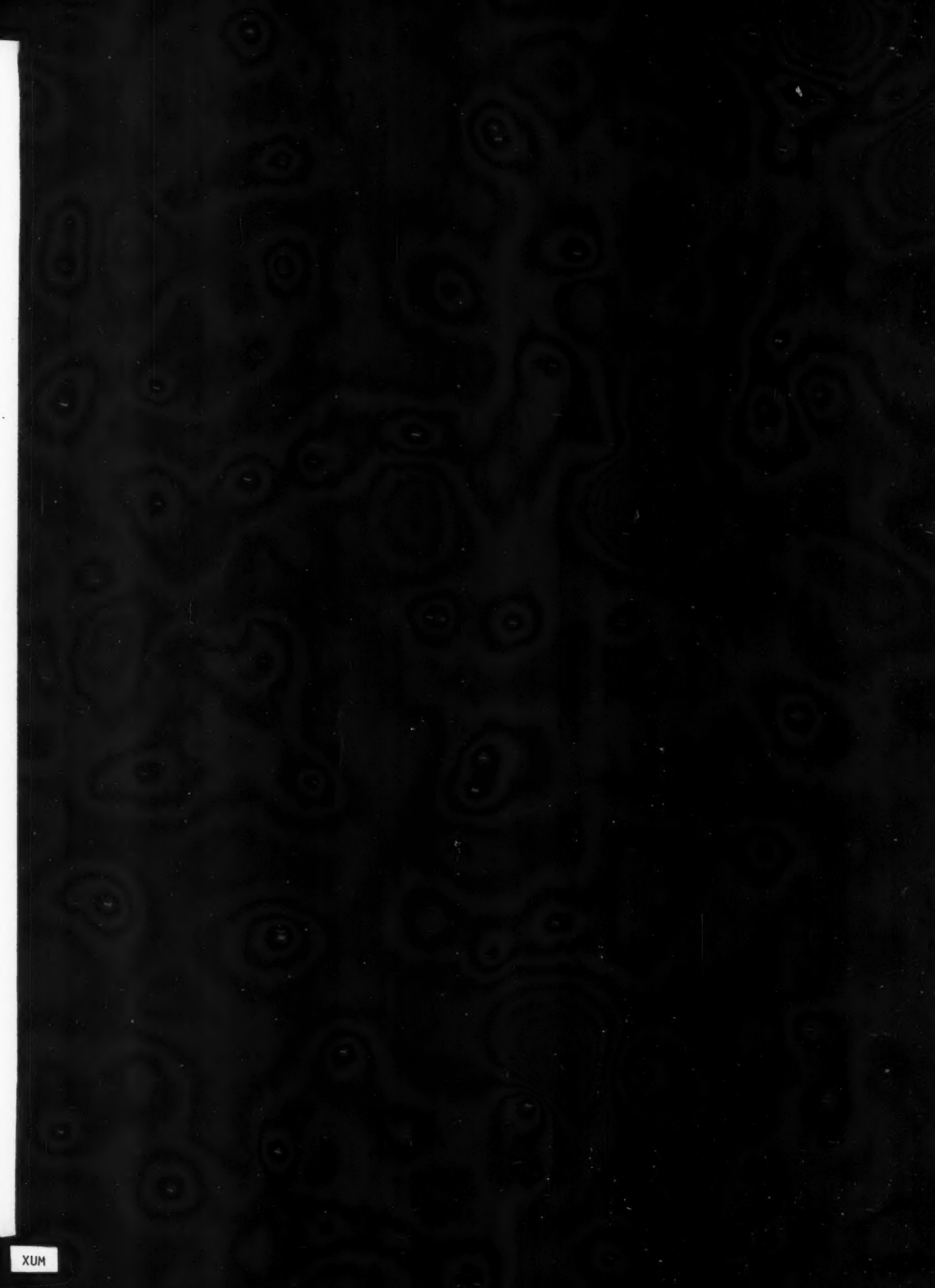

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